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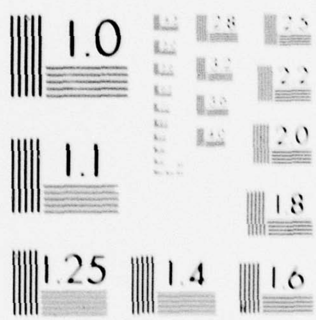

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Single-Shaft Frigate	Crashback Maneuvers

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Aircraft gas turbine engines, as now configured for ship propulsion, are unidirectional in output rotation and, therefore, require the added complexity of a reversing transmission or a reversible-pitch propeller. This study explores the feasibility of a novel reverse-turbine concept which is configured to adapt to existing free-power turbine engines without additional clutches or separate drive trains. This device, termed the "isolated reverse turbine," is

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sized for meeting that most demanding maneuver for a fixed-pitch propeller-driven frigate or destroyer, namely, the crash reversal maneuver.

Through a ship-stopping analysis and utilization of an existing computer program for the design of axial-flow turbines, reverse-turbine size and performance limits are determined. Available windage data are surveyed and summarized, and the ahead-power penalties of four candidate reverse turbines are estimated. The viable alternatives include both single-stage and two-stage impulse turbines sized for stopping distances of 5 and 3.5 ship lengths, respectively. It is concluded that use of the turbines examined would result in 1% to 2% steady-state ahead-power penalties, implying a basic acceptability of this isolated reverse-turbine concept.

The reverse-turbine concept would replace the function of the reversing gear or the reversible-pitch propeller; it could also complement electrically actuated reverse transmissions by eliminating the need for braking resistors and switches. Because of the potentially wide applicability of this reverse-turbine concept, it is recommended that additionaly substantiating data be obtained to demonstrate the practicality of required hardware components. Full-scale development is not recommended at this time because the status of the above-mentioned alternatives has not been fully evaluated.

TABLE OF CONTENTS

	Page
LIST OF FIGURES	iv
LIST OF TABLES	vi
SYMBOLS	viii
SUBSCRIPTS	x
LIST OF ABBREVIATIONS	x
ABSTRACT	1
ADMINISTRATIVE INFORMATION	1
INTRODUCTION	2
SHIP-REVERSING MODEL	7
STUDY-SHIP CHARACTERISTICS	7
AHEAD-TURBINE PERFORMANCE CHARACTERISTICS	11
FIXED-PITCH PROPELLER SELECTION	11
PROPELLER THRUST AND TORQUF CHARACTERISTICS	15
SHIP PROPULSION EQUATIONS	18
SHIP-REVERSING COMPUTER PROGRAM	20
STEADY-STATE AHEAD AND BACKING SHIP PERFORMANCE	21
TRANSIENT RESULTS	24
REVERSE-TURBINE DESIGN	30
AXIAL-FLOW TURBINE DESIGN ANALYSIS	30
REVERSE-TURBINE DESIGN ALTERNATIVES	35
REVERSE-TURBINE TORQUE VERSUS SPEED	38
WINDAGE LOSSES	40
TURBINE ROTOR WINDAGE	41
REVERSE-TURBINE WINDAGE	50
AHEAD-TURBINE WINDAGE	52
DISCUSSION	53
CONCLUSIONS	59

Page

RECOMMENDATIONS 60

ACKNOWLEDGMENT 60

APPENDIX A - PATENT APPLICATION. 61

APPENDIX B - DESCRIPTION OF SHIP-REVERSING COMPUTER PROGRAM 75

APPENDIX C - FORTRAN LISTING OF SHIP-REVERSING COMPUTER PROGRAM. 81

APPENDIX D - SAMPLE OF A STEADY-STATE CALCULATION AND A TRANSIENT CRASHBACK SIMULATION. 97

REFERENCES 119

LIST OF FIGURES

1 - General Electric's Direct-Reversing Turbine Arrangement 3

2 - Isolated Reverse-Turbine Arrangement. 6

3 - Total Ship Resistance Versus Ship Speed for Ahead and Astern Directions 9

4 - Drive Transmission Losses Versus Propeller Rotational Speed. 10

5 - LM2500 Marine Gas Turbine Estimated Average Engine Performance. 12

6 - Ahead-Turbine Torque Versus Fuel Flow Rate for Four Constant-Power Turbine Speeds. 13

7 - Propeller Efficiency and Thrust Coefficient Versus Advance Coefficient J for Three DTNSRDC Propellers. 16

8 - Second Modified Thrust Coefficient Versus Second Modified Advance Ratio. 19

9 - Second Modified Torque Coefficient Versus Second Modified Advance Ratio. 19

Page

10 - Ship Speed, Ahead-Turbine Torque, Ahead-Turbine Power, and Fuel Flow Rate per Engine Versus Ahead-Turbine Speed. 22

11 - Propeller Speed of Advance, Propeller Thrust, Propeller Torque, and Propeller Efficiency Versus Ahead-Turbine Speed 22

12 - Ship Speed, Ahead-Turbine Torque, and Astern-Turbine Power Versus Astern-Turbine Speed. 23

13 - Propeller Speed of Advance, Propeller Thrust, and Propeller Torque Versus Astern-Turbine Speed 23

14 - Simulated Transient Results During Ship Coastdown After Drive Power is Cut 25

15 - Simulated Transient Results of a Crashback Maneuver, Run 1. 26

16 - Simulated Transient Results of a Crashback Maneuver, Run 2. 26

17 - Simulated Transient Results of a Crashback Maneuver, Run 3. 27

18 - Simulated Transient Results of a Crashback Maneuver, Run 4. 27

19 - Simulated Transient Results of a Crashback Maneuver, Run 5. 28

20 - Simulated Transient Results of a Crashback Maneuver, Run 6. 28

21 - Stage Reaction and Exit Swirl Versus Speed-Work Parameter. 32

22 - Astern-Turbine Power Versus Speed for Single-Stage Axial-Flow Impulse Turbines. 33

23 - Astern-Turbine Power Versus Speed for Two-Stage Axial-Flow Impulse Turbines. 34

24 - Astern-Turbine Torque Versus Ratio of Head Reach to Ship Length 36

25 - Astern-Turbine Power Versus Astern-Turbine Speed 36

Page

26 - Velocity Diagrams of a Turbine Stage. 39

27 - Astern-Turbine Torque Versus Astern-Turbine Speed 40

28 - Windage Loss Coefficients k_F and k_B Versus Sum of the Upstream and Downstream Distances Between Rotor and Enclosures. 49

29 - Reverse-Turbine Windage Loss Versus Ahead-Turbine Speed 51

30 - Ahead-Turbine Windage Loss Versus Ahead-Turbine Speed 52

31 - Astern-Turbine Torque Versus Time Lapse 56

A.1 - Isolated Reverse-Turbine System 69

A.2 - Exhaust Elbow (Forward Position). 70

A.3 - Exhaust Elbow (Reverse Position). 70

A.4 - Inlet Valve Mechanism 71

A.5 - Combination Cam/Ring Gear as Viewed from Upstream 72

A.6 - Combination Cam/Ring Gear as Viewed from Downstream 72

A.7 - Guide Ring as Viewed from Upstream. 73

A.8 - Single-Stage, Axial-Flow Reverse Turbine. 74

B.1 - General Flow Diagram of Ship-Reversing Computer Program. 78

B.2 - Flow Relationship of Routines Which Support the Subroutine SHIP 79

LIST OF TABLES

1 - Braking Horsepower Developed for LM2500 Marine Gas Turbine Engine at Indicated Power Turbine Speed (RPM) and Specific Fuel Consumption. 13

2 - Summary of Results for Crashback Simulations 29

3 - Alternative Reverse-Turbine Designs. 37

Page

4 - Rotors Used in Stodola's Windage Test. 42

5 - Stodola's Windage Test Results 44

6 - Summary of Suter and Traupel Windage Test Results. 45

7 - Summary of GE-MARAD Windage Test Results 47

SYMBOLS*

A_a	Turbine exit annulus area, ft^2 (m^2)
A_d	Propeller disk area, ft^2 (m^2)
C	Suter-Traupel windage loss coefficient
C_Q	Second modified torque coefficient
C_T	Second modified thrust coefficient
D	Diameter, ft (m)
g_c	Gravitational constant
Δh	Specific work, Btu/lb (J/kg)
I	Propulsion drive train inertia, lb_m/ft^2 (kg/m^2)
J	Advance coefficient
k	General Electric's windage loss coefficient
k_h	Mechanical equivalent of heat
k_p	Mechanical equivalent of power
K_Q	Torque coefficient
K_T	Thrust coefficient
ℓ	Turbine blade height, ft (m)
$\dot{m}$	Mass flow rate, lb_m/s (kg/s)
M	Ship mass, lb_f-s^2/ft (N-s^2/m)
N	Rotational speed, rpm
P	Power, hp (kW)

*When U.S. Customary Units are indicated, preferred SI Units follow in parenthesis.

Q	Torque, ft-lb_f (N-m)
R_s	Total ship resistance, lb_f (N)
R_{stg}	Turbine stage reaction
t	Time, s
T	Thrust, lb_f (N)
U	Rotor tangential velocity, fps (m/s)
V	Absolute velocity, fps (m/s)
V_a	Propeller speed of advance, fps (m/s)
V_b	Propeller blades' tangential velocity, fps (m/s)
V_r	Relative velocity of propeller inflow, fps (m/s)
V_s	Ship speed, fps (m/s)
ΔV_u	Turbine exit swirl velocity, fps (m/s)
W	Relative velocity, fps (m/s)
$\dot{w}_f$	Fuel flow rate, lb_m/hr (kg/hr)
W_s	Total ship weight, lb_m (kg)
α_1	Turbine stator exit angle, deg
β	Stodola's windage loss coefficient
η_p	Propeller efficiency
θ	Propeller inflow angle, deg
λ	Modified advance ratio
μ	First modified advance ratio
π	Constant = 3.1416
ρ	Density, lb_m/ft (kg/m^3)

σ	Second modified advance ratio
Λ	Speed-work parameter

SUBSCRIPTS

B	Backward rotation
e	Engine
F	Forward rotation
h	Hub
m	Mean
p	Propeller
t	Tip
u	Tangential
x	Axial
1	Stator exit
2	Rotor exit

LIST OF ABBREVIATIONS

bhp	Brake horsepower
Btu	British thermal units
cm	Centimeter
^oC	Degrees Centigrade
CRP	Controllable, reversible pitch
deg	Degree (angular)
^oF	Degrees Fahrenheit
FP	Fixed pitch
fps	Feet per second
$ft\text{-}lb_f$	Foot-pound force

GE	General Electric Company
Gg	Gigagram
hp	Horsepower
J	Joule
K	Degrees Kelvin
Kg	Kilogram
kPa	Kilopascal
kW	Kilowatt
lb_f	Pound force
lb_m	Pound mass
LHV	Lower heating valve
LTDR	Lock train double reduction
m	Meter
MARAD	Maritime Administration (U.S. Department of Commerce)
Mg	Megagram
MN	Meganewton
MW	Megawatt
min	Minute
N	Newton
NASA	National Aeronautical and Space Administration
psia	Pound force per square inch absolute
^oR	Degrees Rankine
rpm	Revolutions per minute
rps	Revolutions per second
s	Second

SFC	Specific fuel consumption
shp	Shaft horsepower
TDF	Thrust deduction factor
WL	Windage loss

ABSTRACT

Aircraft gas turbine engines, as now configured for ship propulsion, are unidirectional in output rotation and, therefore, require the added complexity of a reversing transmission or a reversible-pitch propeller. This study explores the feasibility of a novel reverse-turbine concept which is configured to adapt to existing free-power turbine engines without additional clutches or separate drive trains. This device, termed the "isolated reverse turbine," is sized for meeting that most demanding maneuver for a fixed-pitch propeller-driven frigate or destroyer, namely, the crash reversal maneuver.

Through a ship-stopping analysis and utilization of an existing computer program for the design of axial-flow turbines, reverse-turbine size and performance limits are determined. Available windage data are surveyed and summarized, and the ahead-power penalties of four candidate reverse turbines are estimated. The viable alternatives include both single-stage and two-stage impulse turbines sized for stopping distances of 5 and 3.5 ship lengths, respectively. It is concluded that use of the turbines examined would result in 1% to 2% steady-state ahead-power penalties, implying a basic acceptability of this isolated reverse-turbine concept.

The reverse-turbine concept would replace the function of the reversing gear or the reversible-pitch propeller; it could also complement electrically actuated reverse transmission by eliminating the need for braking resistors and switches. Because of the potentially wide applicability of this reverse-turbine concept, it is recommended that additionally substantiating data be obtained to demonstrate the practicality of required hardware components. Full-scale development is not recommended at this time because the status of the above-mentioned alternatives has not been fully evaluated.

ADMINISTRATIVE INFORMATION

This feasibility study was accomplished under Work Unit 1-2721-152, Element 62543N, Task Area SF43-432-301, Task 12501. The work was done in the Gas Turbines Branch of the Power Systems Division, Propulsion and Auxiliary Systems Department, David W. Taylor Naval Ship Research and

Development Center, through support provided by the Naval Sea Systems Command (SEA 05R13, Mr. C. L. Miller).

INTRODUCTION

Aircraft gas turbine engines, configured for ship propulsion, are being accepted as the most attractive main propulsion unit for future Navy nonnuclear combatant ships. One of the drawbacks of using these engines, however, is the fact that, in their normal configuration, the output shaft of these engines rotates in only one direction. To provide ship maneuverability, including ship backing, a reversing system such as a reversible-pitch propeller would be required.

The reversible-pitch propeller system is 50% heavier than a fixed-pitch system, costs about three times as much, and exacts a penalty of 3% to 10% in ahead power for ship installations of interest. This power penalty is attributed to the added propeller resistance caused by increased hub diameter, support struts, and shafting size required for the controllable-pitch propeller mechanism.

Reversing alternatives that can be utilized with fixed-pitch propellers are the reverse transmission or the reversing engine. Reversing transmissions are accomplished mechanically or electrically. The Navy is currently considering proposals from various gear manufacturers to do preliminary design work on reverse gears. Navy development programs exist for both superconducting and advanced normally conducting electrical transmission systems.

The purpose of the present report is to consider the feasibility of the engine-reversing option by analyzing a particularly attractive isolated reverse-turbine system in terms of ship-stopping capability, turbine size, and ahead-power penalty.

The General Electric Company[1,2*] has designed, built, and tested a reverse-turbine arrangement where the ahead and reverse turbines are in close proximity and concentrically arranged on the same shaft (see Figure 1). Stators perform the required valving function at the respective

*A complete list of references appears on page 119.

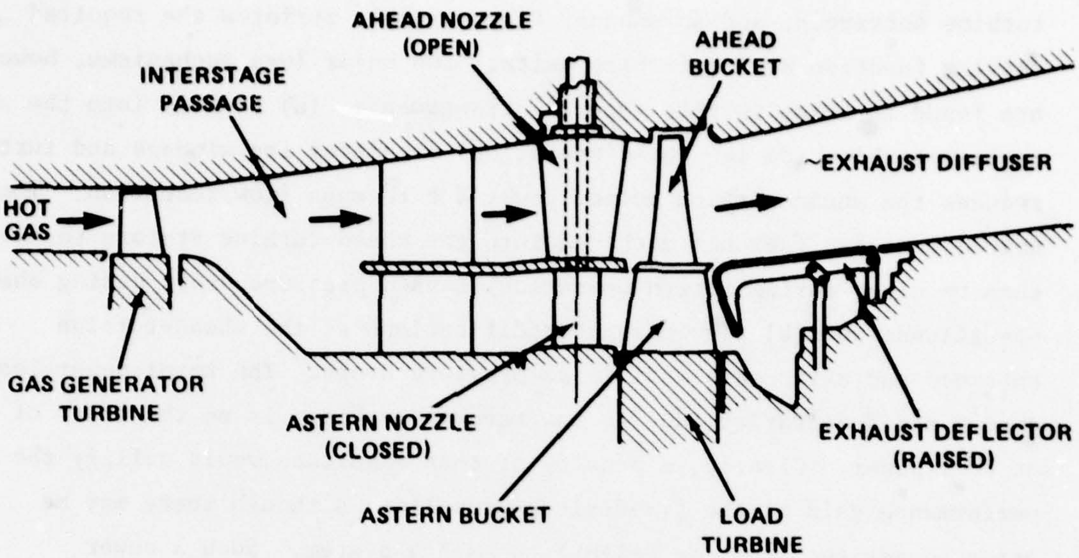


Figure 1a - Ahead Mode

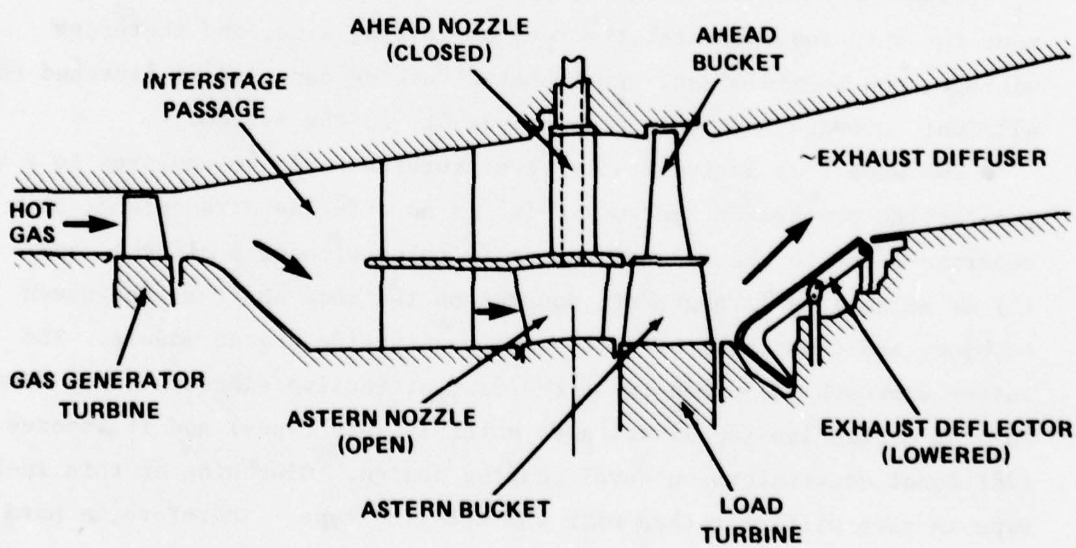


Figure 1b - Astern Mode

Figure 1 - General Electric's Direct-Reversing Turbine Arrangement

turbine entrances, and an exhaust flap assembly performs the required valving function at the turbine exits. Two major loss mechanisms, however, are found to exist in this type of arrangement: (a) Leakage into the reverse turbine (during ahead operation) magnifies its windage and further reduces the ahead-turbine output power due to mass flow reduction. The nozzle recesses (notches machined into the ahead-turbine stators to allow them to close during astern operation) caused pressure drops during ahead operations; and (b) Flow passage modifications at the ahead-turbine entrance and exit cause additional pressure drops. The total power loss during ahead operation, due to the reverse turbine, is on the order of 9% at full power. Clearly, a penalty of this magnitude would nullify the performance gain of the fixed-pitch propeller, although there may be other advantages (cost or weight) to such a system. Such a power penalty is probably typical of "piggyback" reverse-turbine configurations due to the inherent geometric constraints which create leakage paths and flow discontinuities.

Physically isolating the reverse turbine from the ahead turbine should eliminate or minimize most of the loss mechanisms. Furthermore, by sizing the reverse turbine to provide only the torque necessary to meet the ship requirements, the reverse-turbine size, and therefore windage, can be minimized. An isolated turbine can also be clutched to eliminate windage, but this adds complexity to the system.

Two ways that an isolated reverse turbine could be employed in a gas turbine propulsion system are (a) as an off-line arrangement, as a separate input to the reduction gear (with or without a clutch), and (b) as an in-line arrangement, mounted on the same shaft as the ahead turbine, and thus integrated into the gas turbine engine module. The latter approach is judged to be the most attractive since it lends itself to standardization (application to multiple ship types) and it imposes no additional constraints on naval gearing design. Clutching of this in-line type is more difficult than with the off-line type. Therefore, a hard coupling with minimization of windage losses is necessary.

The turbine performance of a particular in-line reverse-turbine system will be analyzed in this report. The analysis emphasizes the determination of reverse-turbine torque requirements as a function of the ship-

stopping requirements, the development of parametric turbine performance and sizing data for one- and two-stage axial-flow turbines, and windage estimates of several selected turbine designs. Taken in total, this analysis will determine the performance feasibility of the isolated, in-line, reverse turbine. The analysis will not evaluate the other components necessary to complete the system.

The particular in-line, isolated, reverse-turbine system of interest is described in the patent application reproduced in Appendix A. As shown in Figure 2, the system contains (a) an inlet valve mechanism which intercepts the gas flow into the ahead turbine and sends it to the astern turbine through the bypass ducting, (b) the reverse turbine itself, and (c) a positionable exhaust valve which blocks flow through either the ahead or the reverse turbine. The bypass ducting contains a shutoff valve which prevents leakage flow from occurring during operation of the ahead turbine.

In regard to turbine torque and ship-stopping requirements, the analysis includes (a) a definition of the characteristics of a notional single-shaft frigate and the ahead turbine, (b) the selection of a fixed-pitch propeller from the available candidates, whose four-quadrant torque and thrust characteristics are known, and the mapping of those characteristics as functions of a modified advance ratio, (c) the definition of the ship propulsion dynamic equations and a description of the ship-reversing computer program necessary to establish the relationship between reverse torque and ship stopping, and (d) the results of the steady-state ahead/backing performance and the transient results for the crashback case of interest. Various torque levels applied to the shaft by the reverse turbine, and the resulting stopping distance, are determined. Transient plots of ship speed, shaft speed, and head reach are made for various reverse-torque levels of interest.

Parametric reverse-turbine design data is developed from an existing NASA* computer program for the preliminary design analysis of axial-flow turbines. The inlet conditions to the reverse turbine are fixed by the

*A complete list of abbreviations and symbols begins on page x.

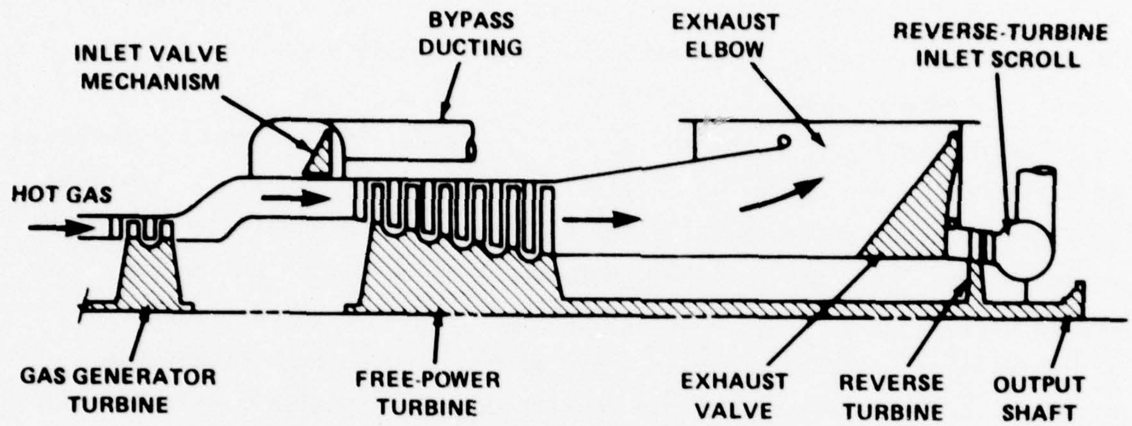


Figure 2a - Ahead Mode

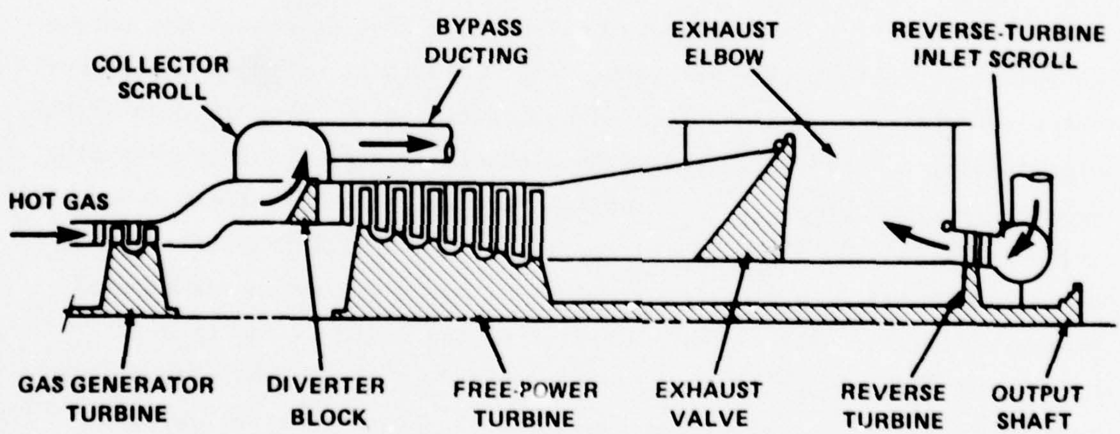


Figure 2b - Astern Mode

Figure 2 - Isolated Reverse-Turbine Arrangement

discharge conditions of the engine's gas generator. Both one- and two-stage reverse turbines are considered. The parametric data is in the form of astern power available as a function of turbine diameter and design speed. Four reverse-turbine design alternatives are considered in detail. The alternatives include both single- and two-stage turbines sized for stopping distances of 3.5 and 5 ship lengths.

Existing windage data are surveyed, the configurations examined, and their results are summarized. Windage calculations of the four reverse-turbine alternatives are made by extrapolating the most applicable experimental data of similar turbine configurations.

SHIP-REVERSING MODEL

The first step towards demonstrating the feasibility of the isolated reverse-turbine system involved determining the reverse-turbine torque needed to meet the stopping distance requirement of a typical gas-turbine-powered combatant during a crashback maneuver. The present analysis is based on the application of this reverse-turbine concept to a notional single-shaft frigate. This section of the report defines the ship, engine, and propeller characteristics of the study ship. Steady-state ahead and backing performance data, as well as transient behavior of the ship during crashback maneuvers, is obtained from a propulsion simulation developed for the study ship. The results of several crashback simulations demonstrate the effect that reverse-turbine torque and time lapse between maximum ahead and astern torque have on stopping distance.

STUDY-SHIP CHARACTERISTICS

The design details of the study ship describe a notional single-shaft frigate having the following characteristics:

Overall length	450 ft (137 m)
Maximum beam	50 ft (15.2 m)
Maximum draft	25 ft (7.61 m)
Full-load displacement	3600 long tons (3658 Mg)
Main propulsion engines	Two LM2500 gas turbines

Total installed power	43,000 shp (32 MW) at 3600 rpm
Drive train	One combining LTDR gear
Propeller	One five-bladed, fixed-pitch screw
Propeller diameter	16.5 ft (5.03 m)
Maximum speed (full load)	30 knots

The total ship weight W_s including 8% entrained water is

$$W_s = 1.08\ (3600)(2240) = 8.7 \times 10^6\ lb_m\ (3.95\ Gg) \tag{1}$$

and the ship mass is

$$M = \left(\frac{W_s}{g_c}\right) = \left(\frac{8.7 \times 10^6}{32.17}\right) = 2.7 \times 10^5\ lb_f\text{-}s^2/ft\ (3.94\ MN\text{-}s^2/m). \tag{2}$$

The ahead and astern ship resistance versus ship speed are shown in Figure 3 for the study ship's assumed operating range of -21 to +30 knots. To satisfy the above design characteristics, the hull resistance at a ship speed of +30 knots must equal the thrust acting on the ship when the total installed power is delivered to the drive train. The ship's powering requirement also reflects the wake fraction, thrust deduction factor, and drive train losses. A value of 0.98 was assumed for the wake fraction, which means the propeller's speed of advance is 98% of ship speed. The thrust deduction factor is the ratio of thrust acting on the ship to thrust developed by the propeller. If thrust is being developed in the ahead direction, a thrust deduction factor of 0.93 is assumed; if thrust is being developed in the astern direction, a thrust deduction factor of 0.85 is assumed. Figure 4 shows the assumed frictional losses in the mechanical drive train as a function of propeller rotative speed N_p.

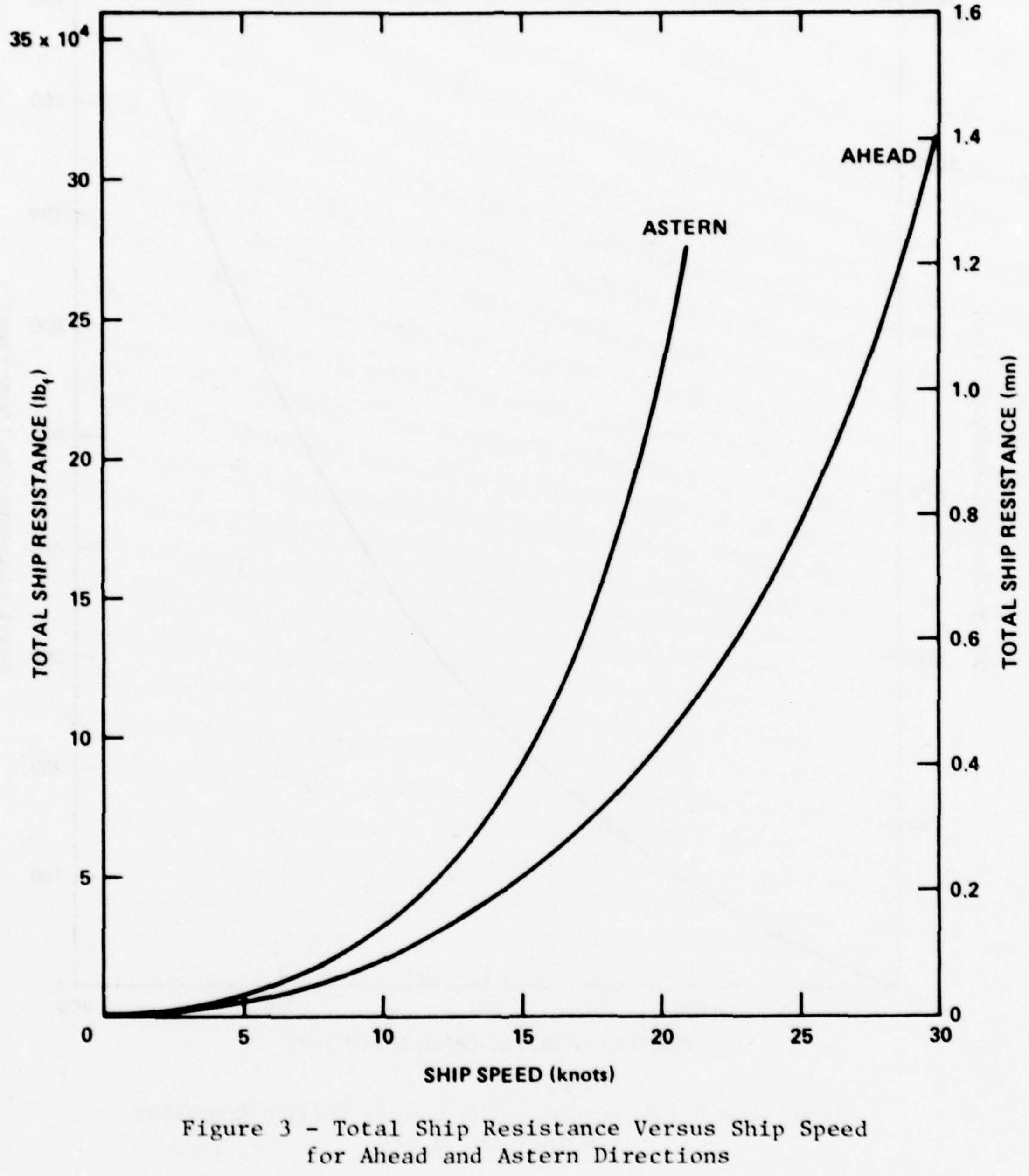


Figure 3 - Total Ship Resistance Versus Ship Speed for Ahead and Astern Directions

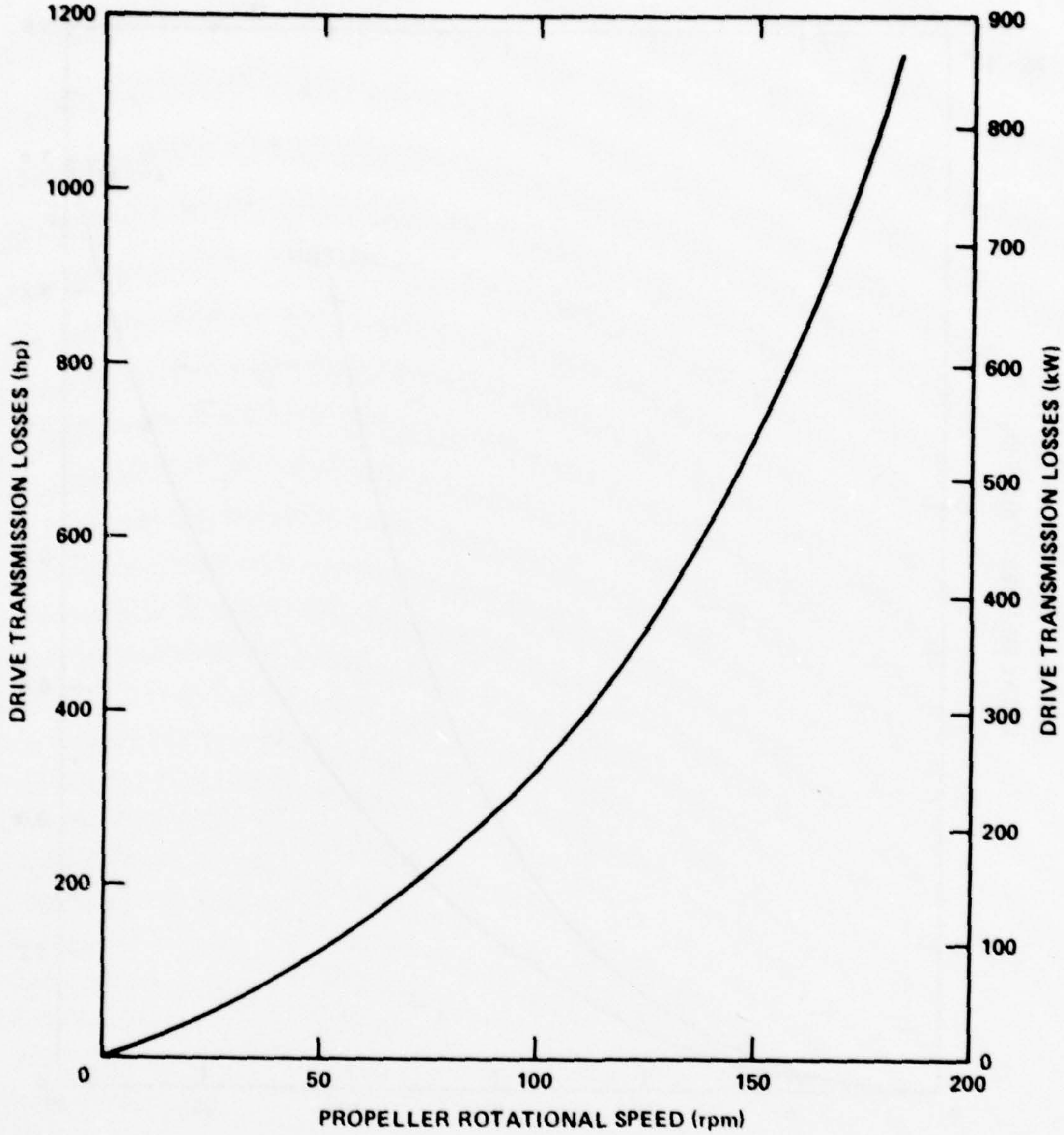


Figure 4 - Drive Transmission Losses Versus Propeller Rotational Speed

AHEAD-TURBINE PERFORMANCE CHARACTERISTICS

The manufacturer's estimated average engine performance for the LM2500 marine gas turbine[3] is reproduced as Figure 5, a plot of engine brake horsepower versus power turbine speed. Note that the power ratings are based on Navy standard operating conditions for shipboard gas turbines. A simple empirical equation for ahead-turbine performance was derived from the data shown in Figure 5. For a given power turbine speed and specific fuel consumption (SFC), a value of brake horsepower was recorded (see Table 1). Using the relationships for converting brake horsepower (bhp) to engine torque Q_e

$$Q_e = \left(\frac{33{,}000 \text{ bhp}}{2\pi \text{ NPT}} \right) \tag{3}$$

and for converting specific fuel consumption to fuel flow rate

$$\dot{w}_f = (\text{bhp}) \times (\text{SFC}), \tag{4}$$

a plot of torque versus fuel flow rate $\dot{w}_f$ (Figure 6) is generated. The data for a constant-power turbine speed are essentially linear and can be fitted with an empirical equation of the form

$$Q_e = (aN_e + b)\,\dot{w}_f + cN_e + d. \tag{5}$$

For Q_e in ft-lb$_f$, N_e in rpm, and $\dot{w}_f$ in lb/hr, the coefficients in Equation (5) are: $a = -0.000925$, $b = 8.25$, $c = -2.5$, and $d = -2100$. For Q_e in N-m, N_e in rpm, and $\dot{w}_f$ in kg/hr, the coefficients in Equation (5) are: $a = -0.002765$, $b = 24.66$, $c = -3.3895$, and $d = -2847$.

FIXED-PITCH PROPELLER SELECTION

Since the objective of this study was to prove feasibility of a concept rather than to design an optimum system, a rigorous propeller design process based on the study ship's characteristics was beyond the scope of work. Therefore, propeller selection was made from readily available four-quadrant open-water data for several fixed-pitch propellers.

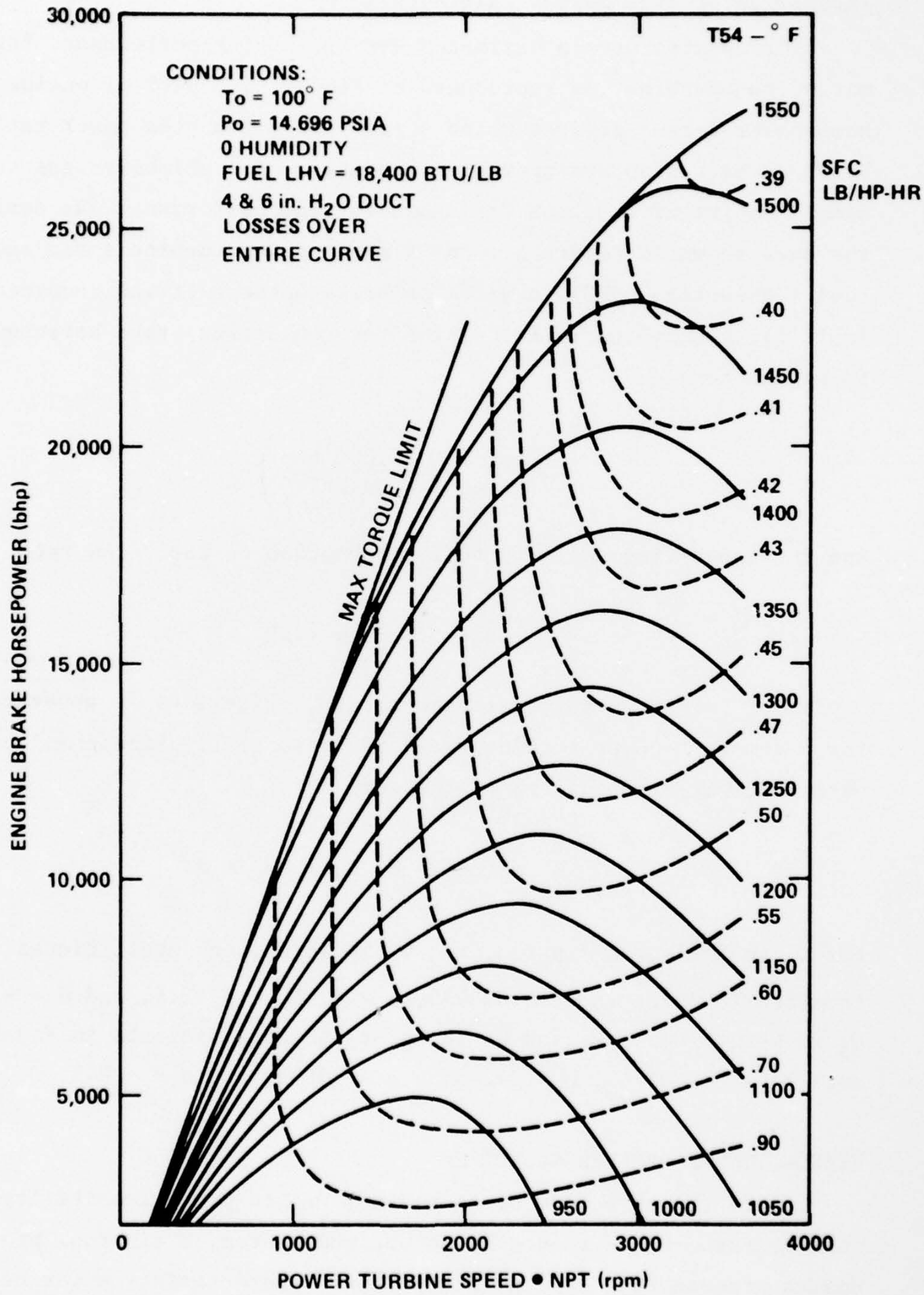


Figure 5 - LM2500 Marine Gas Turbine Estimated Average Engine Performance

TABLE 1 - BRAKING HORSEPOWER DEVELOPED FOR LM2500 MARINE GAS TURBINE ENGINE AT INDICATED POWER TURBINE SPEED (RPM) AND SPECIFIC FUEL CONSUMPTION

SFC (lb/hp-hr)	Braking Horsepower Developed (rpm)			
	2,000	2,500	3,000	3,600
0.90	2,500	2,700	3,100	3,700
0.70	4,100	4,300	4,700	5,650
0.60	5,850	5,900	6,450	7,500
0.55	7,800	7,300	7,800	9,000
0.50	13,400	9,700	10,000	11,200
0.47	-	12,200	12,000	13,300
0.45	-	15,900	13,900	15,100
0.43	-	-	16,750	17,400
0.42	-	-	18,500	18,900
0.41	-	-	20,900	20,600

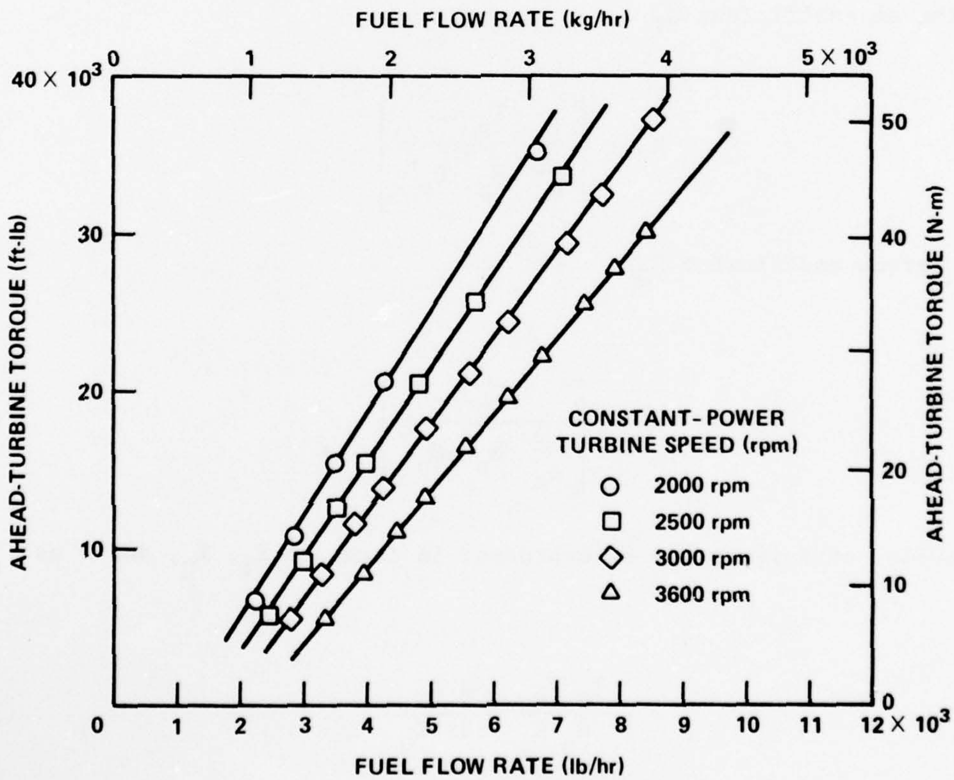


Figure 6 - Ahead-Turbine Torque Versus Fuel Flow Rate for Four Constant-Power Turbine Speeds

During the initial screening of these propellers, some were eliminated because they had fewer than, or more than, fives blades; others were eliminated due to their highly skewed, highly raked designs. Thus the selection was narrowed to three of the several fixed-pitch propellers considered. These were DTNSRDC Propellers 4381, 4382, and 4426.

To choose one of these three propellers, the ahead-quadrant open-water data (i.e., the usual thrust and torque coefficients versus advance coefficient) were examined. The advance coefficient J is defined as

$$J = V_a / N_p \, D_p \tag{6}$$

where the speed of advance of the propeller for a ship speed of 30 knots is

$$V_a = 1.689 \; (0.98) \; (30) = 49.7 \text{ fps } (15.1 \text{ m/s}) \tag{7}$$

and the propeller diameter D_p is 16.5 ft (5.03 m). Given the definitions of the thrust coefficient K_T

$$K_T = \left[\frac{T_p}{\frac{\rho}{g_c} \; N_p^{\;2} \; D_p^{\;4}} \right] \tag{8}$$

and the torque coefficient K_Q

$$K_Q = \left[\frac{Q_p}{\frac{\rho}{g_c} \; N_p^{\;2} \; D_p^{\;5}} \right] , \tag{9}$$

the propeller efficiency may be expressed in terms of K_T, K_Q, and J as

$$\eta_p = \frac{T_p \; V_a}{2\pi \; N_p \; Q_p} = \frac{J \; K_T}{2\pi \; K_Q} \; . \tag{10}$$

The efficiencies of DTNSRDC Propellers 4381, 4382, and 4426 were computed and plotted with thrust coefficient as a function of advance coefficient in Figure 7. The results indicate that, for a given advance coefficient, DTNSRDC Propeller 4426 has about a 2% higher efficiency than the other propellers. However, all three propellers could meet a propeller efficiency requirement of 71% at full power. The advance coefficient J is 0.85 for DTNSRDC Propeller 4426, which from Equation (6) defines the rotational speed of the propeller as

$$N_p = V_a/J\ D_p = 3.54 \text{ rps.} \tag{11}$$

Thus, the reduction gear ratio (ratio of engine output speed to propeller speed) is approximately 17:1. DTNSRDC Propellers 4381 and 4382 have an efficiency of 71% at a higher advance coefficient (J = 0.92); therefore, the rotational speed of these propellers would be slightly less (n = 3.27 rps) and the reduction gear ratio is approximately 18:1. Since either of these three propellers could satisfy our study ship's characteristics by simply adjusting the reduction gear ratio, DTNSRDC Propeller 4426 was arbitrarily selected for this analysis.

During an actual ship design tradeoff analysis, the naval architect would consider many factors other than open-water thrust and torque characteristics before selecting a particular propeller. Such factors, not considered in our selection, would include:

1. Hull and machinery vibrations
2. Propeller blade loads
3. Reduction gear size and weight
4. Delay of cavitation inception.

However, it is not expected that ship-stopping distances will be significantly affected by selection of one or another of these propellers.

PROPELLER THRUST AND TORQUE CHARACTERISTICS

The fixed-pitch propeller thrust and torque characteristics are represented as modified thrust and torque coefficients versus a modified advance ratio λ. The modified advance ratio is nondimensional and is based on the velocity vectors at the propeller's mean-thrust diameter ($0.7\ D_p$):

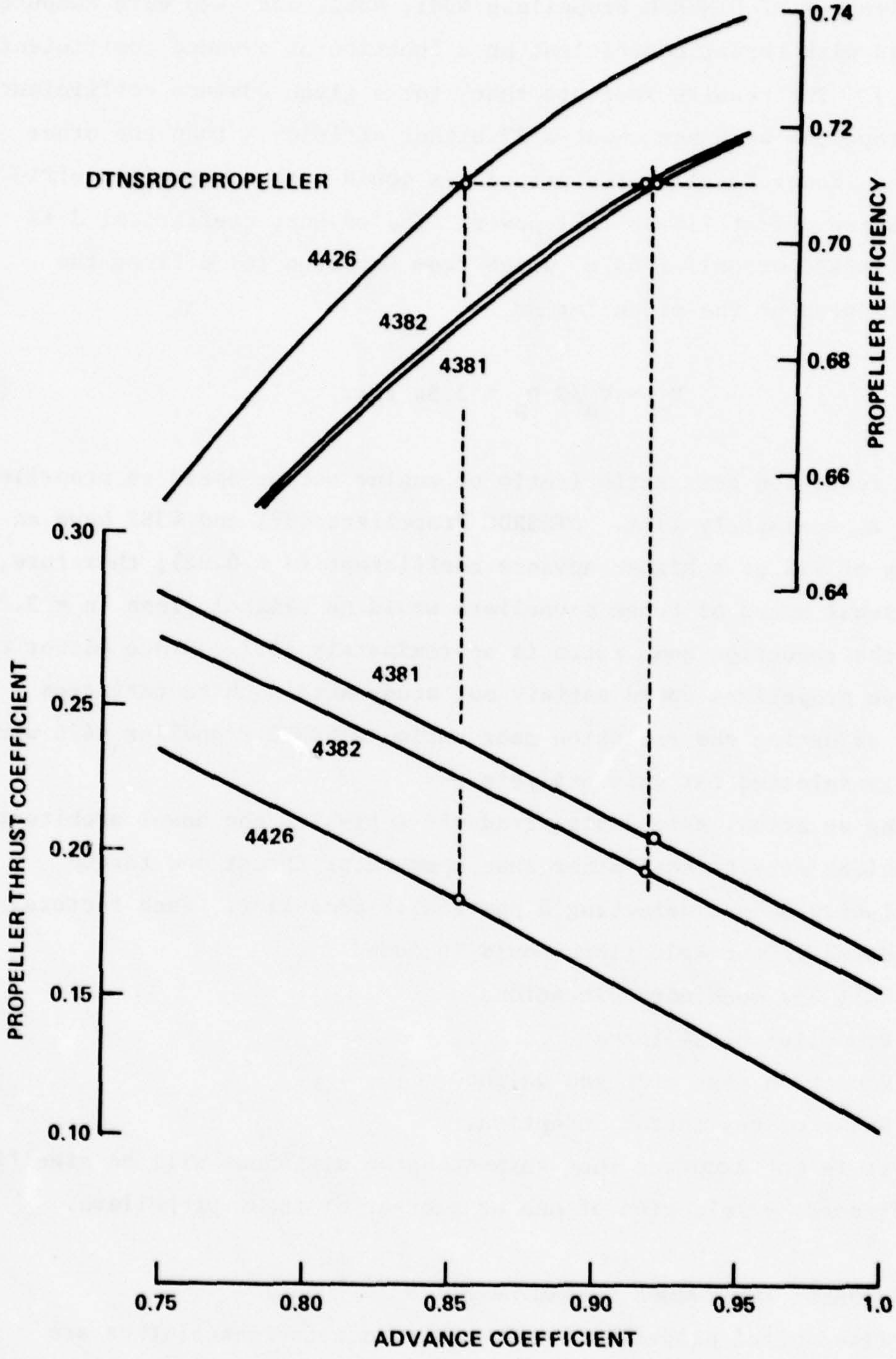


Figure 7 - Propeller Efficiency and Thrust Coefficients Versus Advance Coefficient for Three DTNSRDC Propellers

$$\lambda = V_a/V_b = V_a/(0.7\pi\ N_p\ D_p). \tag{12}$$

The modified advance ratio is also directly proportional to the classical advance coefficient J:

$$\lambda = 0.455\ J. \tag{13}$$

The relative velocity of the propeller inflow is

$$V_r = \sqrt{V_a^{\ 2} + V_b^{\ 2}}\ . \tag{14}$$

The first and second modified advance ratios are the sine and cosine of the inflow angle θ, respectively given by

$$\mu = \sin\theta = V_a/V_r \tag{15}$$

and

$$\sigma = \cos\theta = V_b/V_r\ , \tag{16}$$

and when expressed in terms of the advance coefficient J, by

$$\mu = J\Big/\sqrt{J^2 + 4.84} \tag{17}$$

and

$$\sigma = \left(\frac{1}{J}\right)\Bigg/\sqrt{\left(\frac{1}{J}\right)^2 + 0.208}\ . \tag{18}$$

The second modified thrust and torque coefficients (C_T and C_Q) are related to the classical thrust and torque coefficients (K_T and K_Q) by the expressions

$$C_T = \frac{8}{\pi}\ \sigma^2\ K_T \tag{19}$$

and

$$C_Q = \frac{8}{\pi}\ \sigma^2\ K_Q\ . \tag{20}$$

By substituting the definitions of σ, K_T, and K_Q into the above equations, the second modified thrust and torque coefficients may be expressed in familiar terms:

$$C_T = \frac{(0.7\pi)^2 N_p^2 D_p^2 T_p}{\left(\frac{\pi D_p^2}{4}\right) N_p^2 D_p^2 \left(\frac{\rho}{2g_c}\right) V_r^2} = \frac{4.84 T_p}{A_d V_r^2} \tag{21}$$

and

$$C_Q = \frac{(0.7\pi)^2 N_p^2 D_p^2 Q_p}{\left(\frac{\pi D_p^2}{4}\right) N_p^2 D_p^3 \left(\frac{\rho}{2g_c}\right) V_r^2} = \frac{4.84 Q_p}{A_d D_p V_r^2} . \tag{22}$$

Using Equations (18) through (20) and the open-water data given for DTNSRDC Propeller 4426, the second modified thrust and torque coefficients were calculated. Open-water data was not given in the region of σ's between ± 0.11. Expressions for locked-shaft thrust and torque were used to calculate C_T and C_Q at a second modified advance coefficient equal to zero. Smooth curves were faired between $\sigma = 0$ and $\sigma = \pm 0.11$. Figures 8 and 9 are plots of second modified thrust and torque coefficients versus the second modified advance coefficient σ.

SHIP PROPULSION EQUATIONS

The steady-state and dynamic propulsion equations are the final ingredients of the mathematical model. Under steady-state conditions, the net power P_{net} of the propulsion system must equal zero:

$$P_{net} = P_e - \left(\frac{P_p + P_\ell}{\text{No. of engines}}\right) = 0 \tag{23}$$

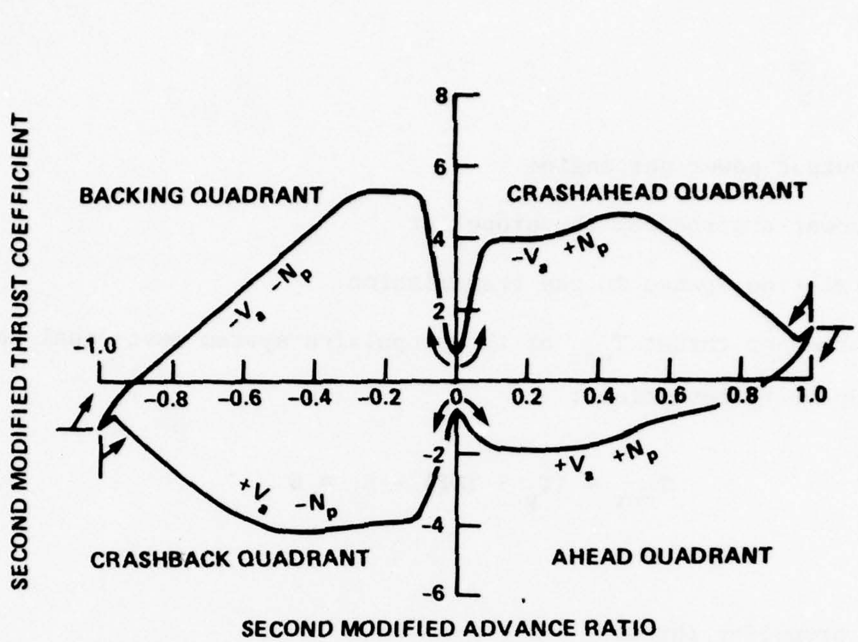


Figure 8 - Second Modified Thrust Coefficient Versus Second Modified Advance Ratio

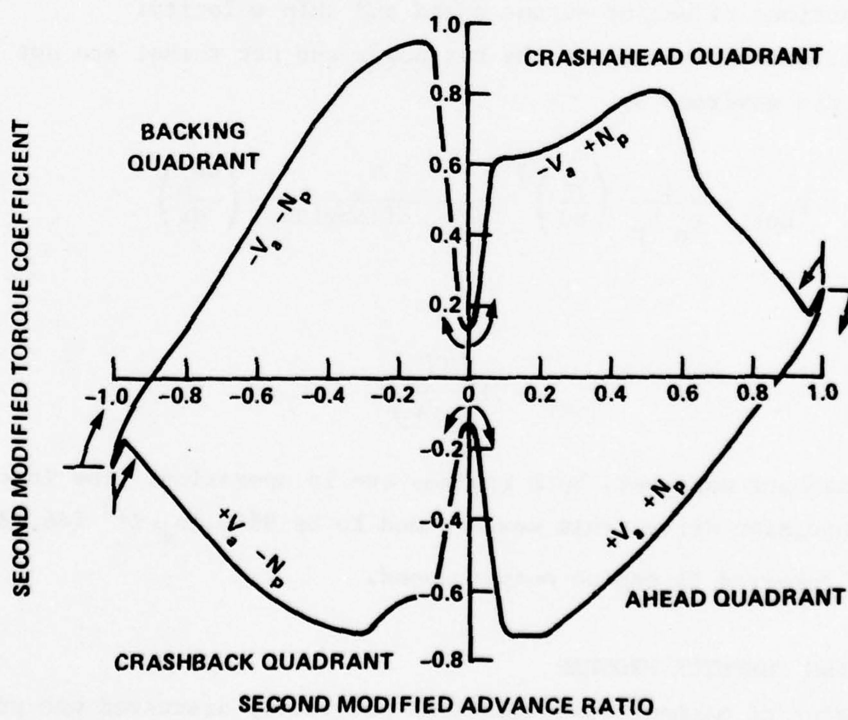


Figure 9 - Second Modified Torque Coefficient Versus Second Modified Advance Ratio

where

P_e = output power per engine

P_p = power absorbed by the propeller

P_ℓ = friction losses in the transmission.

Similarly, the net thrust T_{net} of the propulsion system must equal zero under steady-state conditions:

$$T_{net} = (T_p \cdot TDF) - R_s = 0 \tag{24}$$

where

T_p = propeller thrust

TDF = thrust deduction factor

R_s = total ship resistance.

It is apparent from earlier discussion that net power and net thrust are implicit functions of engine output speed and ship velocity.

Under transient conditions the net power and net thrust are not equal to zero but are governed by

$$P_{net} = \frac{1}{g_c\ k_p}\left(\frac{2\pi}{60}\right)^2 \frac{I\ N_e}{(\text{No. of engines})}\left(\frac{dN_e}{dt}\right) \tag{25}$$

and

$$T_{net} = M\left(\frac{dV_s}{dt}\right). \tag{26}$$

During a crashback maneuver, both engines are in operation. The inertia I of the propulsion drive train was assumed to be 9600 lb_m-ft^2 (46,780 kg-m^2) when referred to engine output speed.

SHIP-REVERSING COMPUTER PROGRAM

The system of mathematical equations previously discussed was programmed for finite-difference solutions on the Control Data Corporation (CDC) 6700 digital computer. An iterative approach is used to determine

solutions for the two independent variables, engine output speed and ship speed. Correct values are found only when the definitions of the two dependent variables, net power P_{net} and net thrust T_{net}, are satisfied within a finite tolerance. A modified Newton-Raphson technique is employed to ensure fast and reliable convergence. The initial programming dealt with development and verification of the steady-state calculations in the computer program. However, the primary goal in this effort was to develop a computer program with dynamic capabilities which could then be used to evaluate the ship-stopping characteristics of a reverse turbine. Details of this computer program, including flow charts, nomenclature, program listing, and input/output examples, are given in Appendix B. Attention is given now to steady-state and transient results obtained using the ship-reversing computer program.

STEADY-STATE AHEAD AND BACKING SHIP PERFORMANCE

The ship-reversing computer program was first used to calculate the ship's ahead-power characteristics between idle and design engine speeds. In the steady-state ahead mode, the input to the ship-reversing computer program includes a specified fuel flow rate per engine and initial guesses for the engine output speed and ship speed. Solutions for seven ahead operating points were calculated. The results are summarized in Figures 10 and 11, which show ship velocity, ahead turbine power and torque, fuel flow rate per engine, propeller speed of advance, propeller thrust and torque, and propeller efficiency, all as functions of ahead-turbine speed.

Subsequently, the ship-reversing computer program was used to calculate the study ship's backing characteristics across the range of engine operating speeds. In the steady-state backing mode, the astern-turbine torque is specified, and initial guesses for engine output speed and ship speed have negative values. Solutions for six steady-state points in the backing quadrant were calculated. The results are shown in Figures 12 and 13.

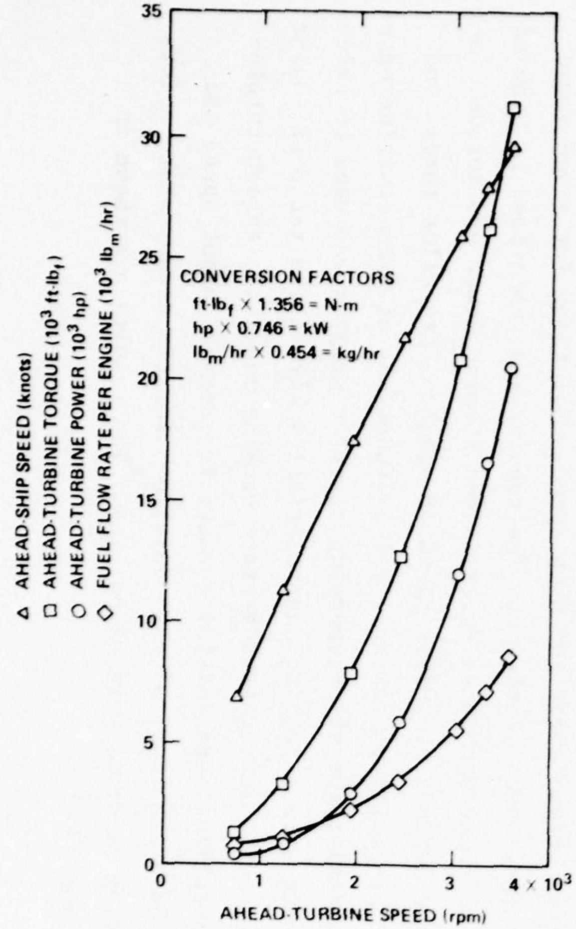


Figure 10 - Ship Speed, Ahead-Turbine Torque, Ahead-Turbine Power, and Fuel Flow Rate per Engine Versus Ahead-Turbine Speed

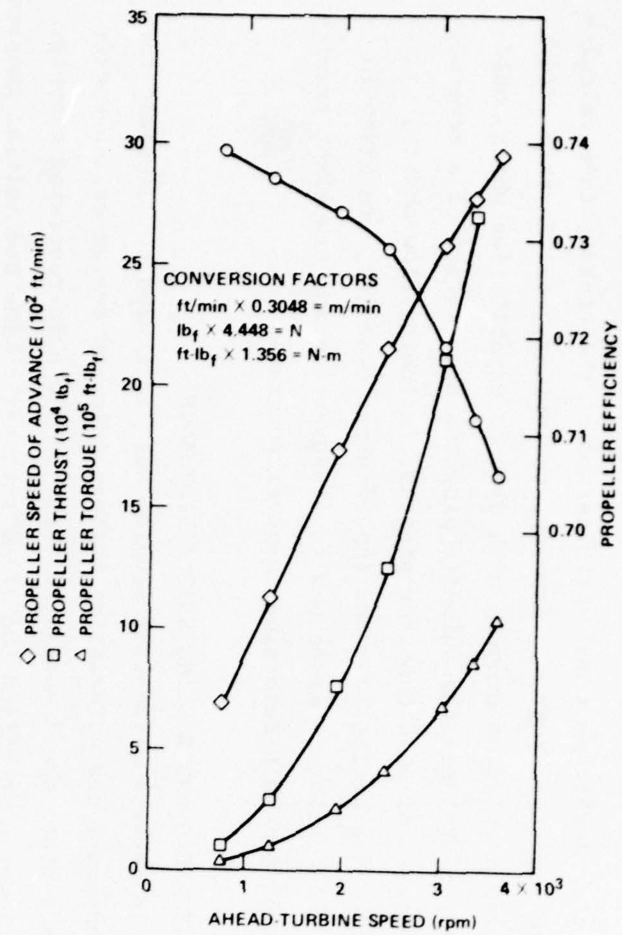


Figure 11 - Propeller Speed of Advance, Propeller Thrust, Propeller Torque, and Propeller Efficiency Versus Ahead-Turbine Speed

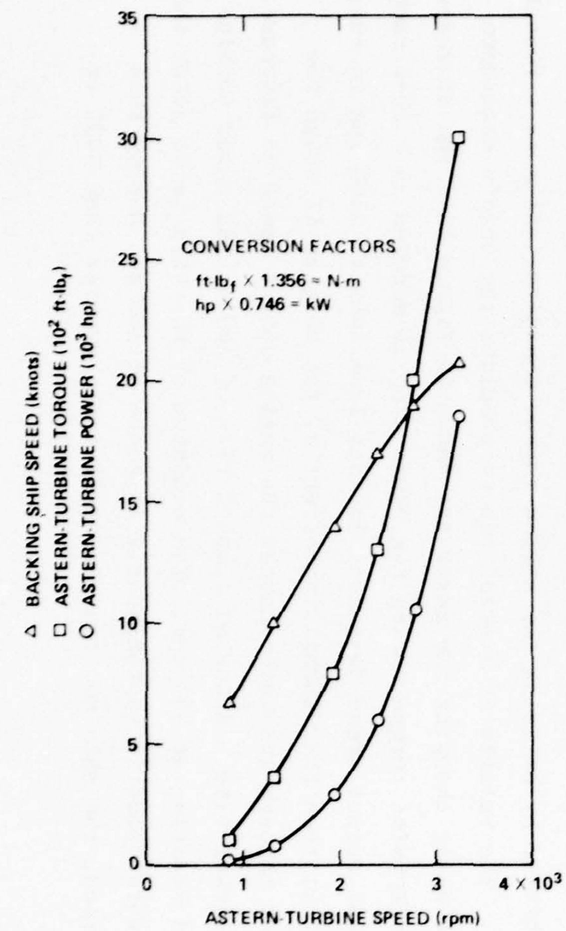


Figure 12 - Ship Speed, Ahead-Turbine Torque, and Astern-Turbine Power Versus Astern-Turbine Speed

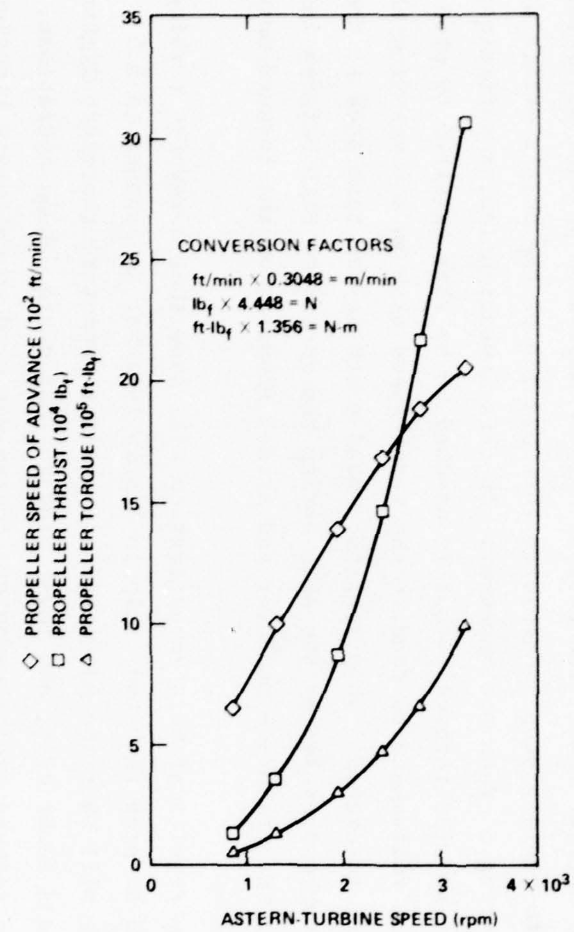


Figure 13 - Propeller Speed of Advance, Propeller Thrust, and Propeller Torque Versus Astern-Turbine Speed

TRANSIENT RESULTS

The steady-state data shown in Figure 12 indicates that a backing ship speed of 15 knots is easily achieved with twin 4000 shp (2984 kW) reverse turbines. In addition to providing steady-state backing power to the propeller shaft, the reverse turbine must also provide sufficient torque to rapidly stop and reverse the rotation of the ship's entire drive train during a crashback maneuver. In this investigation, a sufficient level of reverse-turbine torque is assumed to be that required to stop the ship from full-ahead to dead in the water speed with an accompanying head reach not to exceed 5 ship lengths. Head reach is the term used to denote the distance traveled by the ship during the period of time between initiation of the crashback maneuver and actual stopping of the forward motion of the ship.

The results of this investigation will show that a reverse turbine designed to stop the study ship in 5 ship lengths, as opposed to 3.5 lengths, will have the advantages of smaller diameter, therefore lighter weight and lower cost, and lower windage loss during ahead operations.

The ship-reversing computer program was used to calculate transient ship behavior by defining the engine torque characteristics as a function of time. The results of a trial run to simulate the ship's coastdown behavior after chopping the power are shown in Figure 14. The decrease in ahead-turbine torque during the power drop is modeled as a 10-s ramp. The engine output speed decreases rapidly from 3600 to 2300 rpm in these first 10 s; then the windmilling effect of the ship as it drags the propeller through the water causes the engine output speed to decrease at a much slower rate. After an elapsed time of 100 s, the ahead turbine is still rotating at 900 rpm. The momentum of the ship is so great that its forward speed is approximately 11 knots at 100 s. During this time period, the ship has traveled a distance greater than 3000 ft (914 m).

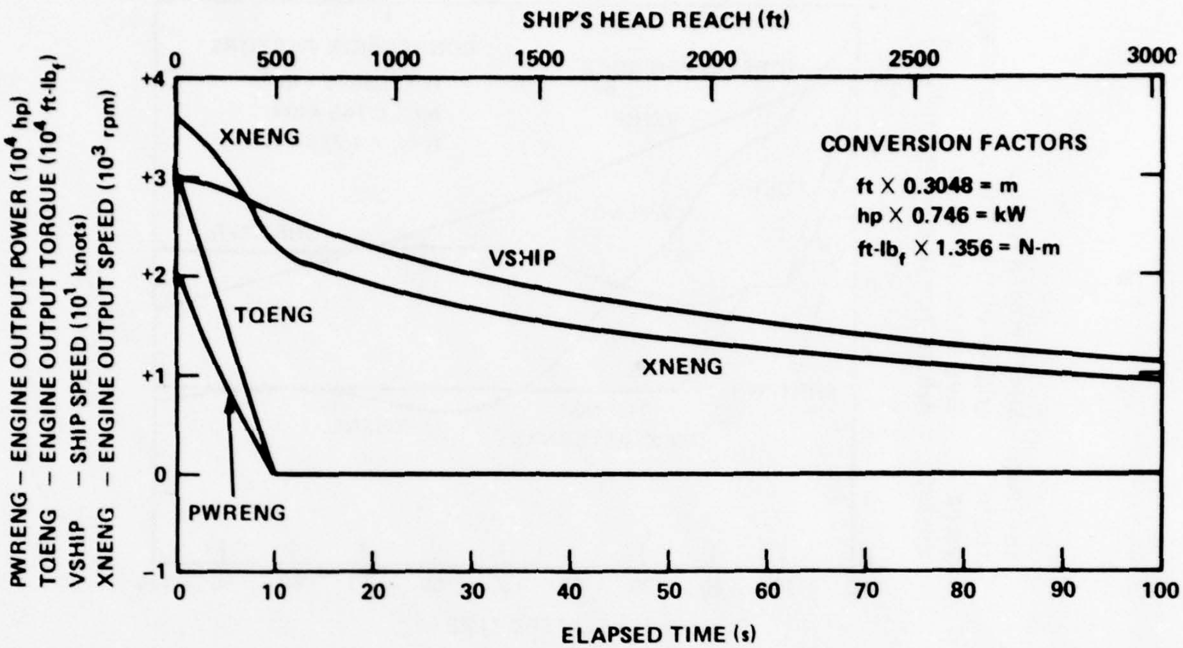


Figure 14 - Simulated Transient Results During Ship Coastdown After Drive Power is Cut

To simulate a crashback maneuver, a four-part engine torque-versus-time function was devised. The four parts represent (a) a period of decreasing (positive) ahead-turbine torque, (b) an intermittent period of zero torque when gas generator discharge is being diverted from the ahead turbine to the astern turbine, (c) a period of increasing (negative) astern-turbine torque, and (d) a period of maximum astern-turbine torque. Several crashback maneuvers were simulated to determine the effect of this torque-versus-time characteristic on ship-stopping distance. Figures 15 through 18 show the effect of varying the maximum astern-turbine torque from 50% to 100% of this initial design ahead torque. The time lapse between maximum ahead and astern torques was 25 s in these four cases. Figures 19 and 20 show the effect of cutting the time lapse to 12.5 s. The results of these six crashback simulations are summarized in Table 2.

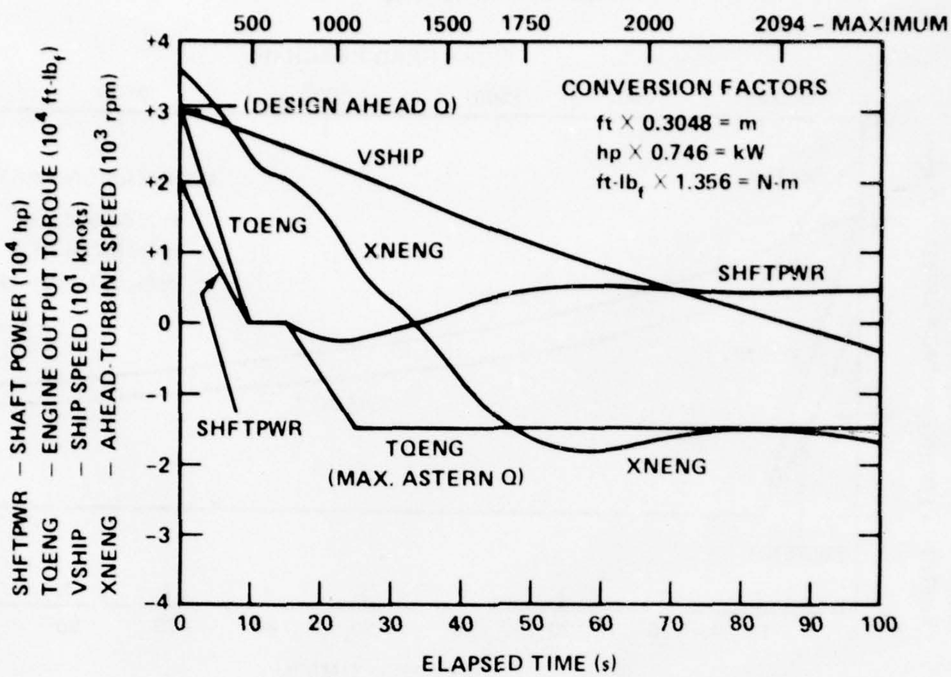


Figure 15 - Simulated Transient Results of a Crashback Maneuver, Run 1

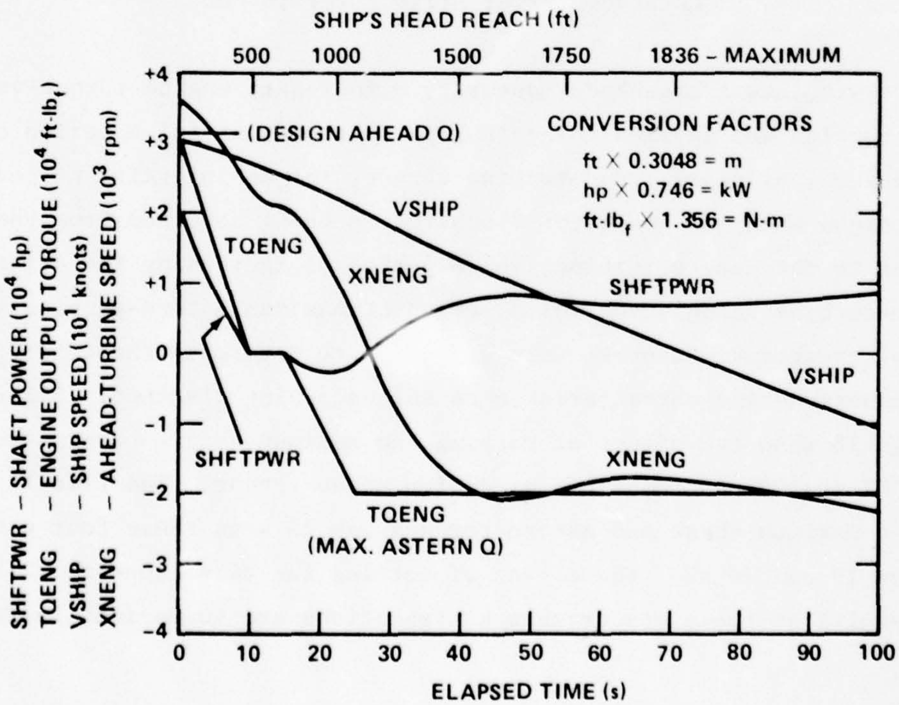


Figure 16 - Simulated Transient Results of a Crashback Maneuver, Run 2

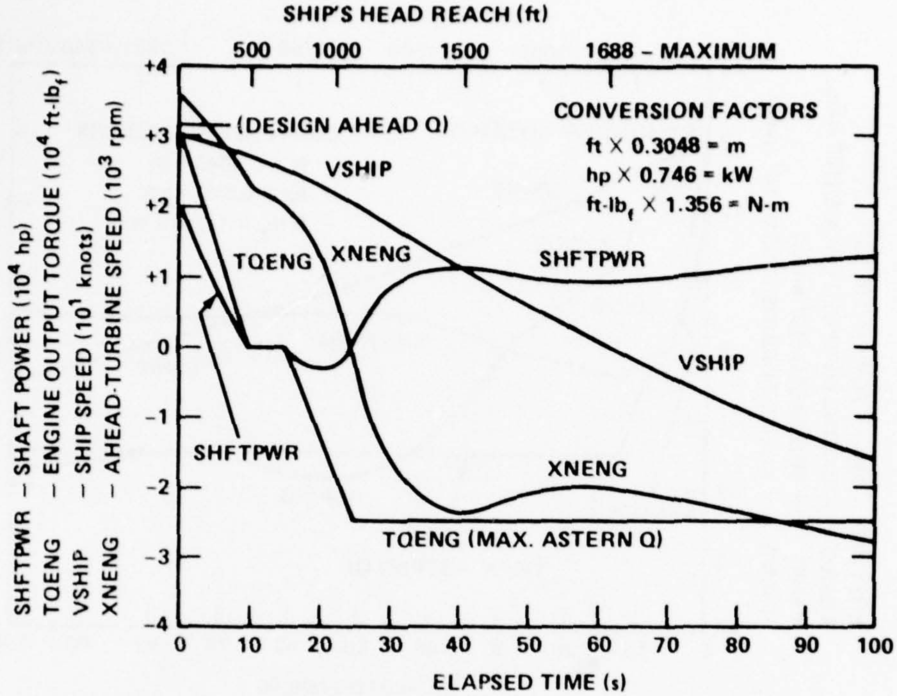


Figure 17 - Simulated Transient Results of a Crashback Maneuver, Run 3

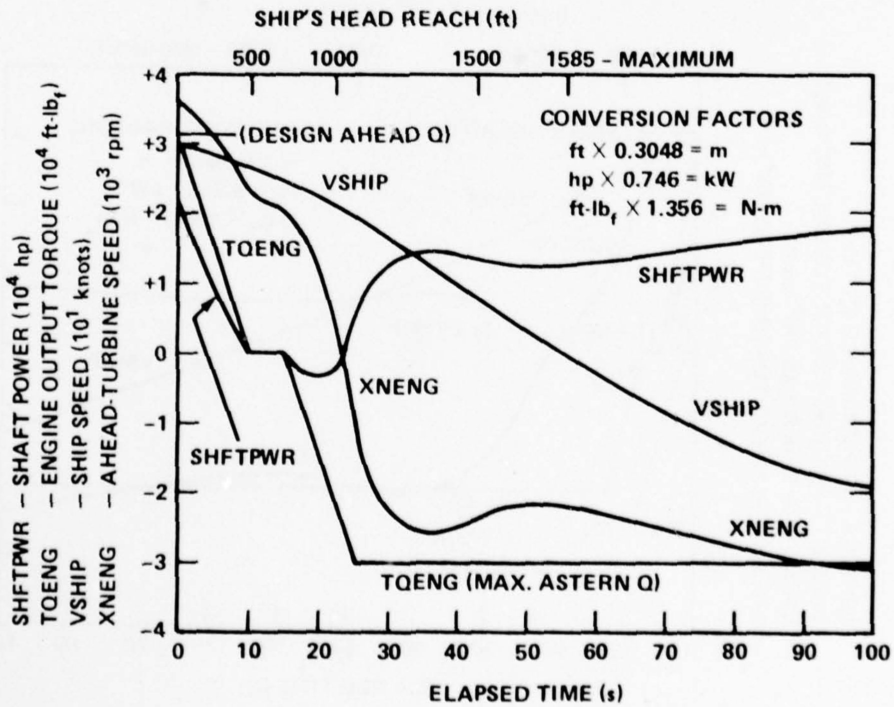


Figure 18 - Simulated Transient Results of a Crashback Maneuver, Run 4

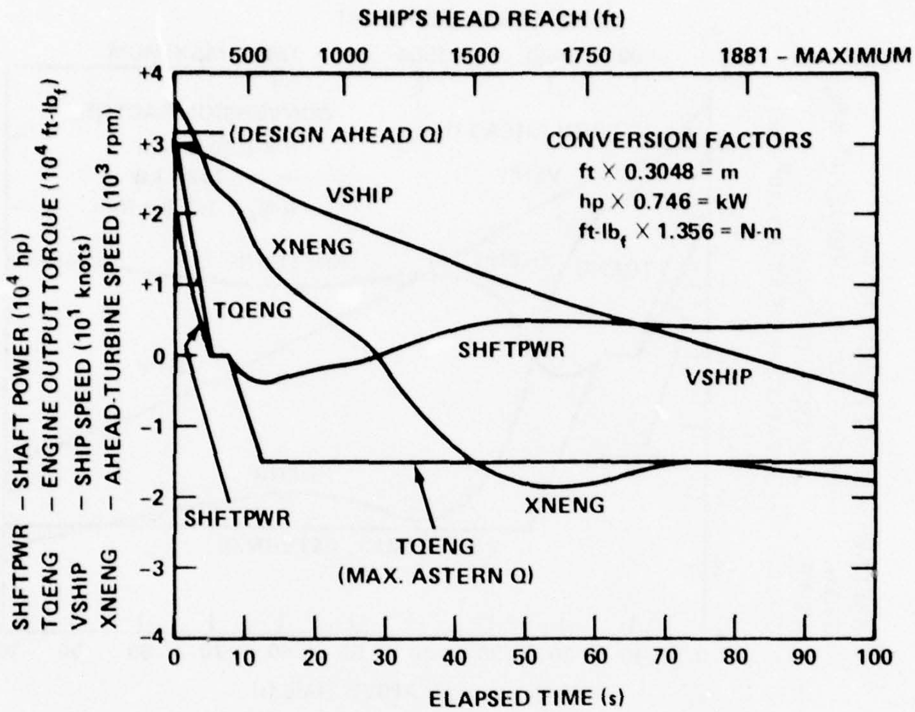


Figure 19 - Simulated Transient Results of a Crashback Maneuver, Run 5

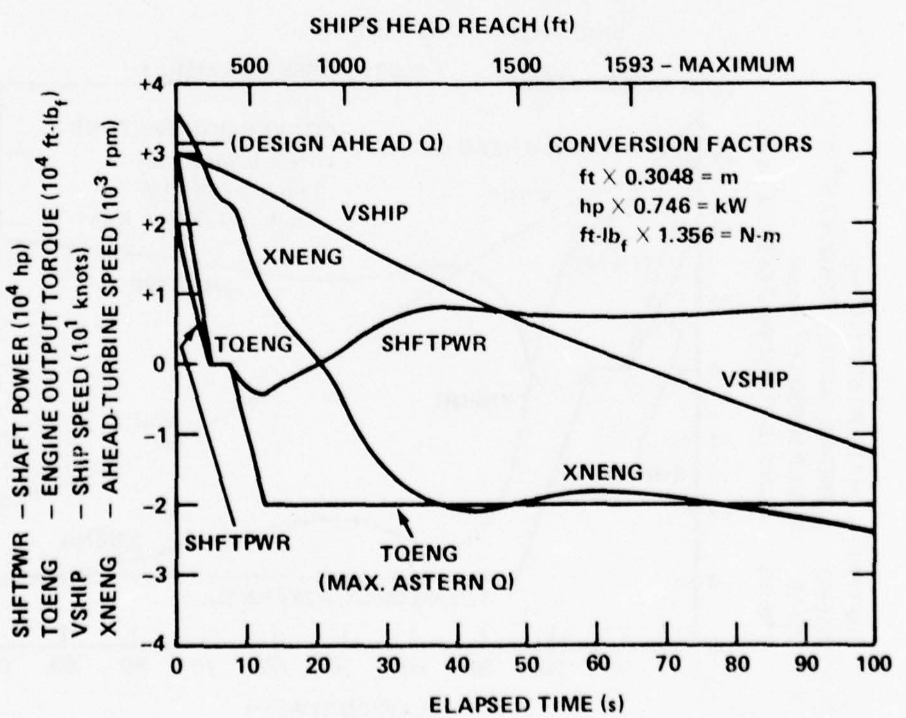


Figure 20 - Simulated Transient Results of a Crashback Maneuver, Run 6

TABLE 2 - SUMMARY OF RESULTS FOR CRASHBACK SIMULATIONS

	Run					
	1	2	3	4	5	6
Time Lapse Between Ahead and Astern Maximum Torques (s)	25	25	25	25	12.5	12.5
Maximum Astern Torque (ft-lb$_f$ (N-m))	15,000 (20,340)	20,000 (27,120)	25,000 (33,900)	30,000 (40,680)	15,000 (20,340)	20,000 (27,120)
Time Elapsed Before Propeller Shaft Speed Equals Zero (s)	33.5	27	24.5	23.5	29	20.5
Time Elapsed Before Ship Speed Equals Zero (s)	86	71	62	56	81	65
Maximum Head Reach (ft (m))	2,094 (638)	1,836 (560)	1,688 (515)	1,585 (483)	1,881 (573)	1,593 (486)
Ratio of Head Reach to Ship Length	4.65	4.08	3.75	3.52	4.18	3.54
Peak Astern-Turbine Speed (rpm) While Ship Speed > 0	1,830	2,120	2,370	2,600	1,830	2,120
Peak Astern-Turbine Power (hp (kW)) While Ship Speed > 0	5,230 (3,902)	8,080 (6,028)	11,300 (8,430)	14,870 (11,093)	5,230 (3,902)	8,080 (6,028)

The results of Run 1 show that reverse turbines having 50% of the design ahead torque could stop the study ship in 4.65 ship lengths, which is slightly better than the acceptable head reach. Runs 1 through 4 show that increasing the astern torque to 100% of design ahead torque will reduce the ship-stopping distance to 3.52 ship lengths. The results of Runs 5 and 6 demonstrate the benefit of bringing the astern turbine up to maximum torque in the shortest possible period of time. By cutting in half the time lapse between maximum ahead and astern torques, the ship-stopping distance can be reduced by half a ship length. Thus, a short ship-stopping requirement can be achieved with a reverse turbine having lower torque and smaller diameter, if the reversing actuation is rapid (i.e., approximately 12 s).

During each crashback simulation, negative shaft power is shown during a period when speed and torque of the reverse turbine have opposite signs. This implies that the inertia of the decelerating ship (not the engines) is driving the propeller and that energy is absorbed aerodynamically by the backwards spinning reverse turbine (air brake).

REVERSE-TURBINE DESIGN

The typical ship application analysis gave some insight into the design point torque and speed needed in a reverse turbine to meet steady-state backing and transient ship-stopping requirements. The second step towards demonstrating the feasibility of the isolated reverse-turbine system involved preliminary design of the reverse turbine. Investigating the effect of ship-stopping requirement on reverse-turbine geometry was of particular interest. This section of the report discusses the computer program used for axial-flow turbine design, the parametric results generated for one- and two-stage impulse turbines, and the four alternative reverse-turbine designs selected for further investigation. Based on the rapid response of the LM2500 gas generator, a time lapse (or reverse-turbine activation time) of about 12.5 s is a reasonable assumption. Under these circumstances, a minimum level of reverse-turbine torque of 10,000 ft-lb_f (13,560 N-m) is needed to stop the ship in 5 ship lengths. Twice this level of torque would be needed to stop the ship in 3.5 ship lengths.

AXIAL-FLOW TURBINE DESIGN ANALYSIS

The reverse-turbine designs were generated using a computer program developed by NASA for preliminary design analysis of axial-flow turbines.[4] The turbine design computations are based on mean-diameter flow properties and do not allow for radial gradients. Specified inputs to the program are pressure ratio, mass flow rate, inlet temperature and pressure, turbine loss coefficient and the gas properties. The inlet and exit tip diameters, and the exit hub-to-tip radius ratio are varied to determine the required reverse-turbine geometry for a given output power and speed. Computations are performed for any specified number of stages and for any of three types of velocity diagrams (symmetrical, zero exit swirl, or impulse). The program output includes inlet and exit annulus dimensions, exit temperature and pressure, total and static efficiencies, blading angles, and last-stage critical velocity ratios.

The inlet temperature, pressure, and mass flow rate of the reverse turbine were defined by the discharge conditions of the LM2500 gas generator. The operating point was selected near 90% gas generator speed which gave:

1. Inlet total pressure = 48.9 psia (337 kPa)
2. Inlet total temperature = 1920 R (1067 K)
3. Mass flow rate = 118.8 lb_m/s (53.9 kg/s).

The selected operating point of the gas generator puts the pressure ratio in the neighborhood of 3.2, depending upon the pressure drop in the bypass ducting and the exhaust duct losses. Three independent variables were varied in the reverse-turbine design analysis to parametrically determine their effects on output power. Rotational speeds of 3600, 3000, 2400, and 1800 rpm were considered; tip diameter was varied from 24 to 60 in. (61 to 152 cm), and exit hub-to-tip radius ratio was varied from 0.1 to 0.9. Another consideration in the analysis was whether to use symmetrical, zero-exit-swirl, or impulse blading in the reverse turbine. Figure 21 shows the effects of speed work parameter on the stage reaction and exit swirl characteristics of each type of blading.[5] The speed-work parameter is defined as

$$\Lambda = \frac{U_m^2}{(g_c \; k_p \; \Delta h)} \; . \tag{27}$$

Zero-exit-swirl blading is seldom used when the speed-work parameter is less than 0.5, to avoid potentially high losses associated with negative stage reaction. Because swirl velocity decreases stage work, impulse blading is seldom, if ever, used when the speed-work parameter is greater than 0.5. The good stage reaction of symmetrical blading is characteristic of high total efficiency, making this type of blading attractive for stages where exit swirl is not a loss (such as the front and middle stages of a multistage turbine). The range of input data in this design analysis is such that the speed-work parameter is consistently less than 0.5; thus, impulse blading was selected for the reverse turbine. To minimize size, cost, and complexity only single- and two-stage turbines without exit guide vanes were considered.

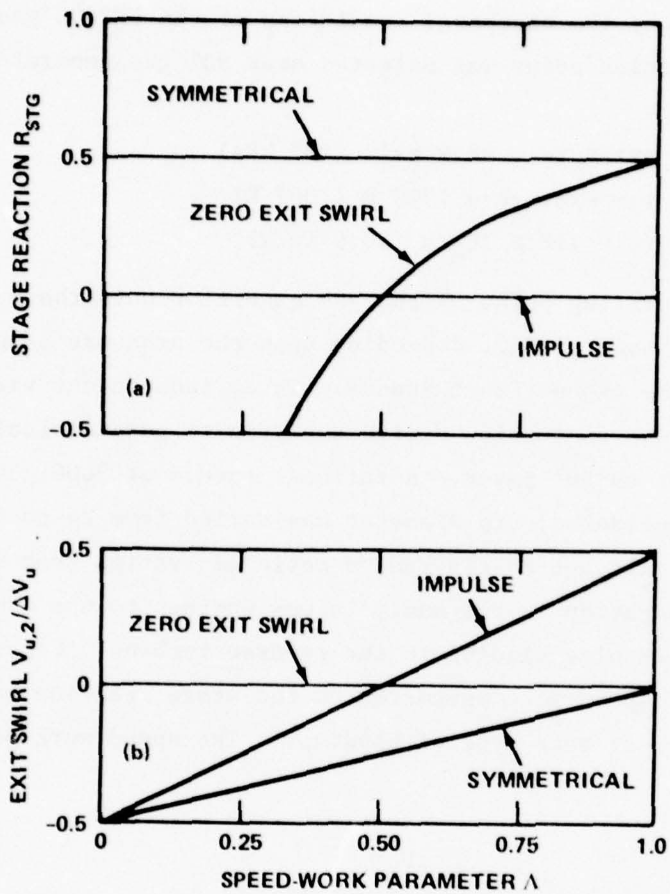


Figure 21 - Stage Reaction and Exit Swirl Versus Speed-Work Parameter

The results obtained with the axial-flow turbine design program are summarized in Figures 22 and 23 for single- and two-stage impulse turbines, respectively. Note that for a given design point speed and power, the two-stage turbine has a substantially smaller tip diameter than the single-stage turbine. Depending upon the particular speed and power in question, the difference between tip diameters may range from 25% to 30% smaller. An advantage of the two-stage turbine may be lower windage loss; however, geometric constraints must be considered also.

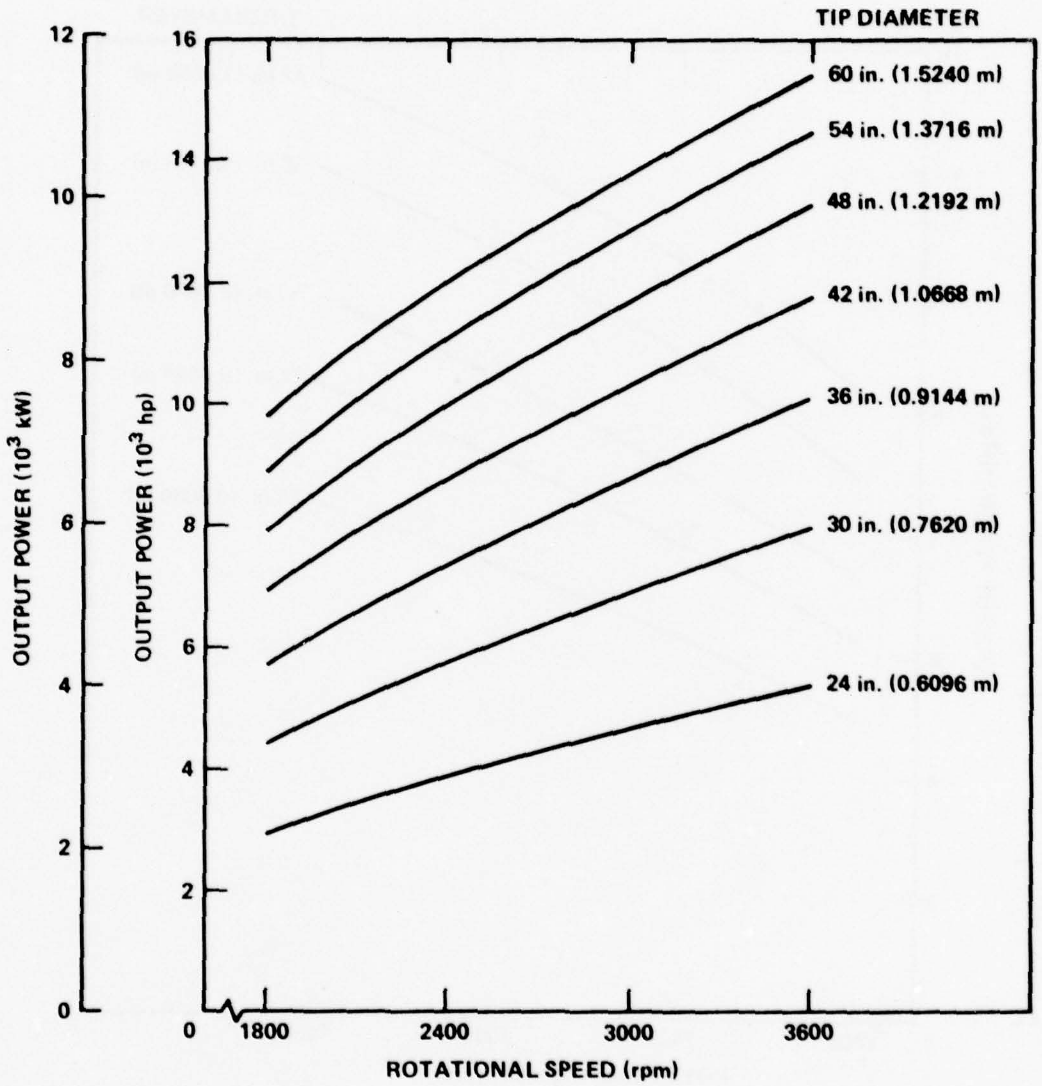


Figure 22 - Astern-Turbine Power Versus Speed for Single-Stage Axial-Flow Impulse Turbines

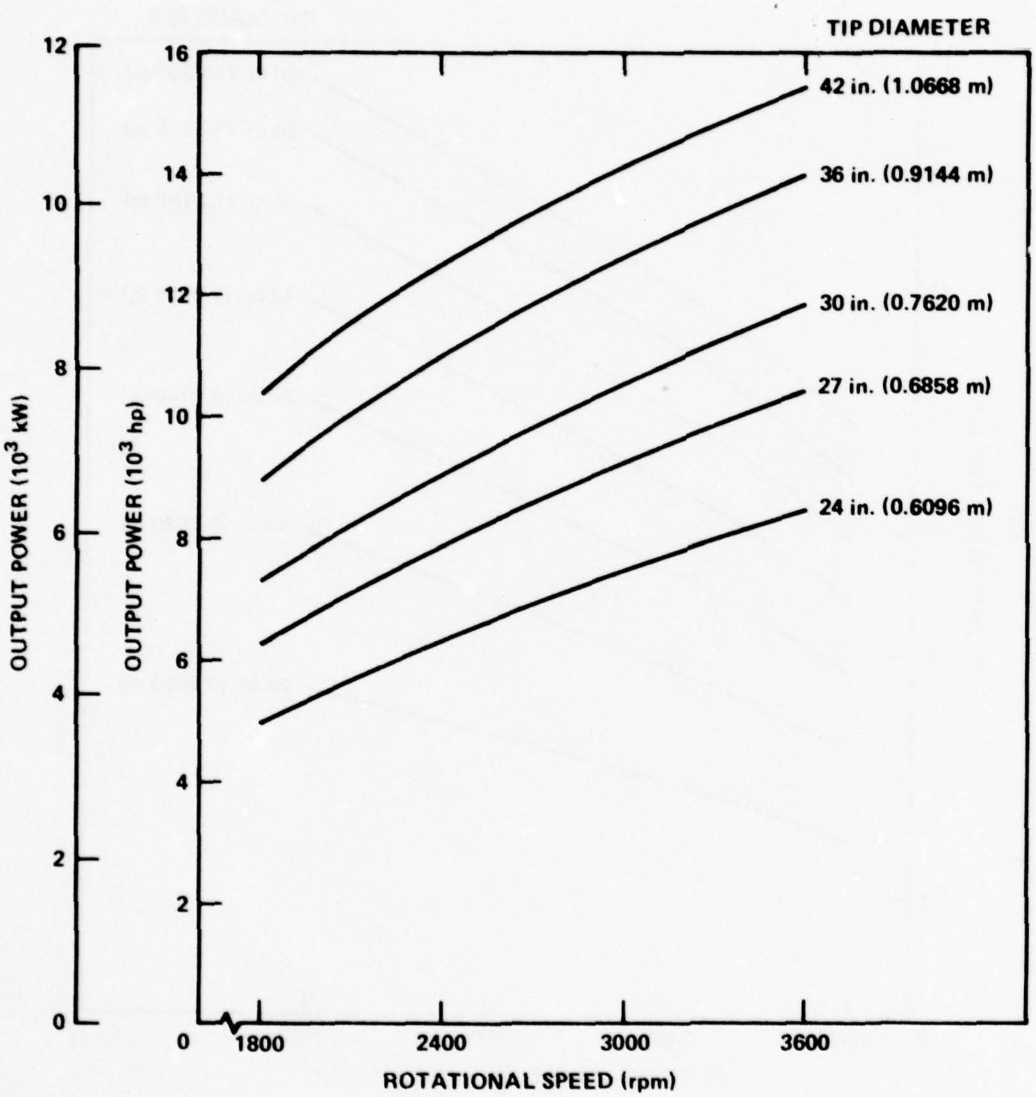


Figure 23 - Astern-Turbine Power Versus Speed for Two-Stage Axial-Flow Impulse Turbines

In going from a single stage to two stages, the length of the reverse turbine obviously increases. The two-stage turbine having a small tip diameter may also have a hub diameter that is too small to be mounted on the output shaft of the LM2500 gas turbine.

REVERSE-TURBINE DESIGN ALTERNATIVES

The results of the transient analysis have shown that the astern-turbine torque requirement and therefore turbine size is significantly influenced by how rapidly the reverse turbine can be brought on-line and by what ship-stopping distance is required. Figure 24 is a plot of astern torque requirement versus stopping distance for a 12.5- and 25-s time lapse between ahead and astern maximum torques. Note that rapidly bringing the reverse turbine on-line is more critical for shorter stopping distances. In this investigation, four alternate designs for the reverse turbine will be presented. The alternatives include both single- and two-stage turbines, sized for stopping distances of 3.5 and 5 ship lengths. The alternate designs are designated as reverse-turbine Models I through IV. Models I and II have approximately 10,000 ft-lb_f (13,560 N-m) of astern torque, and if brought on-line in 12.5 s can stop the 30-knot ship in 5 ship lengths. Models III and IV have approximately 20,000 ft-lb_f (27,120 N-m) of astern torque, and if brought on-line in 12.5 s can stop the 30-knot ship in 3.5 ship lengths. As indicated in Figure 24, the stopping distance of Models III and IV increases to 4.1 ship lengths if brought on-line in 25 s instead of 12.5 s. Models I and III are single-stage turbines, while Models II and IV are two-stage turbines.

The details for these four alternate designs were generated with the axial-flow turbine design program. The inlet mass flow rate, pressure, and temperature remain the same as those given earlier, and a design point speed of 2150 rpm was selected based on the cumulative results of the transient cases having 12.5-s time lags. As shown in Figure 25, a steady-state backing velocity of 15 knots corresponds to an astern-turbine speed of 2150 rpm. Allowing a small margin for ahead windage loss, the power requirement is about 4500 shp (3357 kW) for Models I and II, and about 8500 shp (6341 kW) for Models III and IV. Our previous turbine sizing calculations indicate that Model I is a 27.5-in.-diameter (69.9-cm),

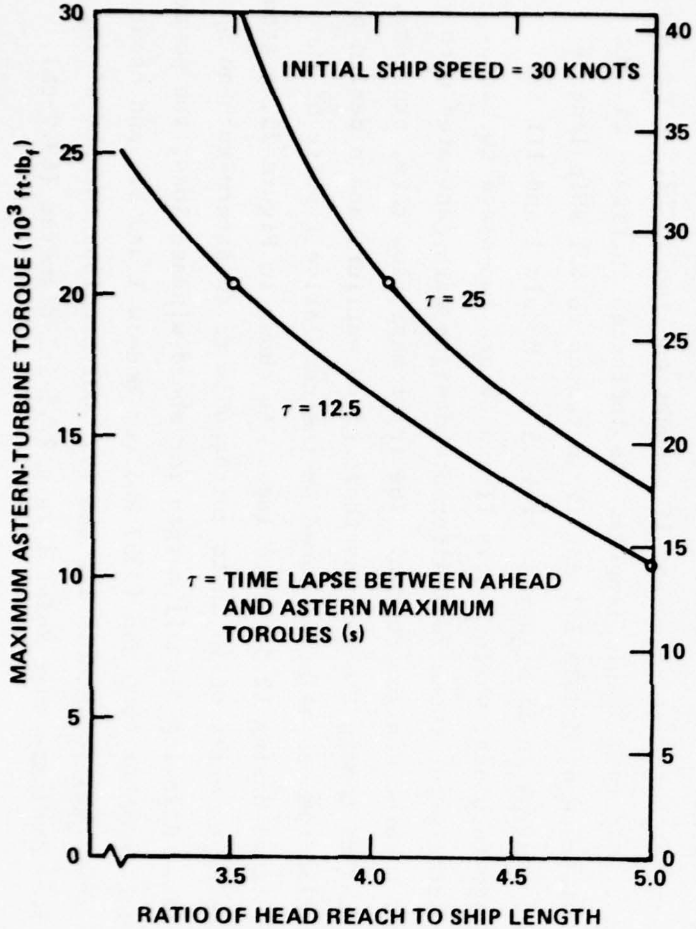


Figure 24 - Astern-Turbine Torque Versus Ratio of Head Reach to Ship Length

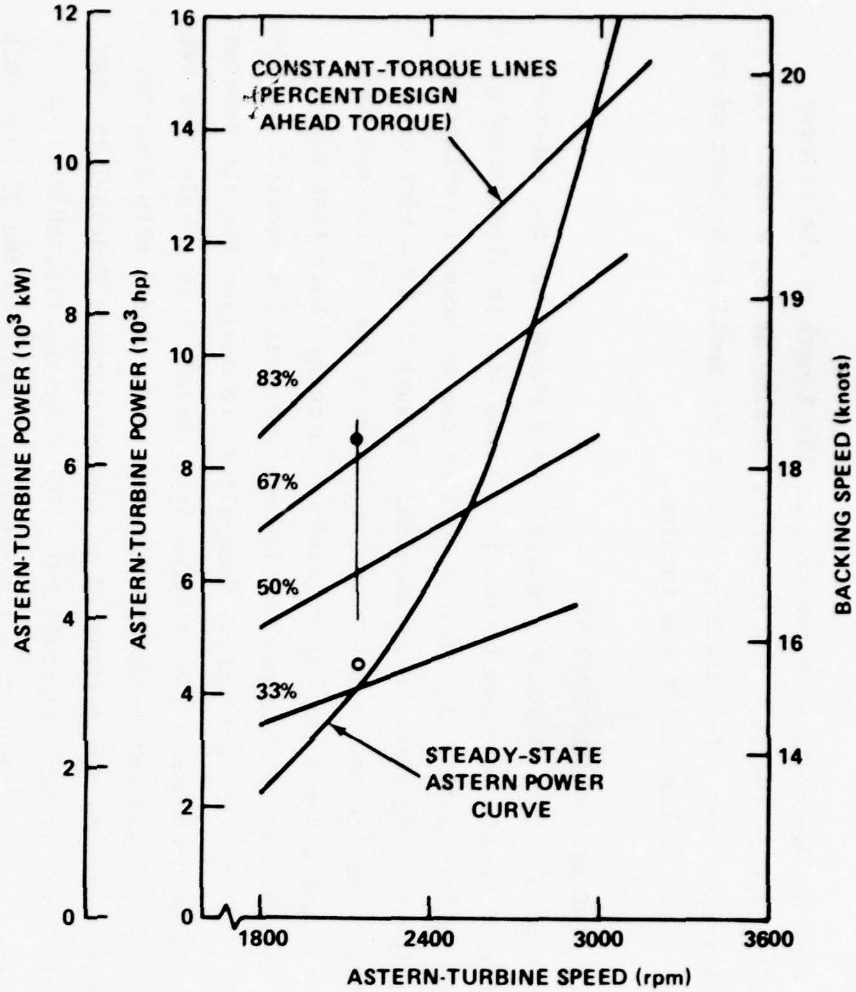


Figure 25 - Astern-Turbine Power Versus Astern-Turbine Speed

single-stage turbine; Model II is a 22-in.-diameter (55.9-cm), two-stage turbine; Model III is a 45-in.-diameter (114-cm), single-stage turbine; and Model IV is a 30.5-in.-diameter (77.5-cm), two-stage turbine. The inlet and exit annulus dimensions, exit temperature and pressure, total and static efficiencies, blading angles, etc, for the four alternate reverse-turbine designs are given in Table 3. As a result of minimizing the diameter of the reverse turbines, the static efficiencies are all below 40%. In this application, however, efficiency of the reverse turbine is not important as long as sufficient reversing torque is available. Some of the data shown in Table 3 will be used to calculate the torque-versus-speed characteristic and the windage loss associated with each reverse-turbine design.

TABLE 3 - ALTERNATIVE REVERSE-TURBINE DESIGNS

	Model I	Model II	Model III	Model IV
Number of Impulse Stages	1	2	1	2
Inlet-Exit Tip Diameter, in. (cm)	27.5 (69.85)	22 (55.88)	45 (114.3)	30.5 (77.47)
Inlet Hub Diameter, in. (cm)	13.75 (34.925)	9.21 (23.393)	33.75 (85.725)	19.84 (50.394)
Exit Hub Diameter, in. (cm)	13.75 (34.925)	4.4 (11.176)	33.75 (85.725)	12.2 (30.988)
Shaft Power, hp (kW)	4501 (3356)	4562 (3402)	8567 (6388)	8537 (6366)
Rotational Speed, rpm	2150	2150	2150	2150
Exit Total Temperature, ^{o}R (K)	1826 (1014)	1825 (1014)	1741 (967)	1742 (967)
Exit Static Temperature, ^{o}R (K)	1520 (844)	1538 (854)	1552 (862)	1573 (874)
Exit Total Pressure, psia (kPa)	32.78 (226)	31.13 (215)	24.65 (170)	23.32 (161)
Exit Static Pressure, psia (kPa)	15.28 (105)	15.28 (105)	15.28 (105)	15.28 (105)
Stator Exit Angle, deg	53.68	35.95	66.19	55.17
Stage Exit Angle, deg	-47.39	-30.27	-55.73	-46.68
Rotor Inlet Angle, deg	50.75	33.20	61.82	51.31
Rotor Exit Angle, deg	-50.75	-33.20	-61.82	-51.31
Total Efficiency, %	53.3	48.2	61.3	56.9
Static Efficiency, %	20.0	20.3	38.2	38.0
First-Stage Mean Speed, ft/s (m/s)	194 (59.1)	146 (44.5)	369 (112)	236 (71.9)
Last-Stage Mean Speed, ft/s (m/s)	194 (59.1)	124 (37.8)	369 (112)	200 (61.0)
Last-Stage Inlet Swirl, ft/s (m/s)	1926 (587)	1268 (386)	2097 (639)	1528 (466)
Last-Stage Exit Swirl, ft/s (m/s)	-1539 (-469)	-1020 (-311)	-1358 (-414)	-1128 (-344)
Last-Stage Axial Velocity, ft/s (m/s)	1415 (431)	1748 (533)	925 (282)	1064 (324)
Exit Axial Mach Number	0.76	0.94	0.49	0.56

REVERSE-TURBINE TORQUE VERSUS SPEED

In the transient analysis of the reverse turbine's ship-stopping capability, it was assumed that the reverse turbine was a constant torque device. In fact, the torque of a turbine rotor varies with rotor speed. The torque-versus-speed characteristic can be calculated from the turbine stage's velocity diagram because net rotor torque is proportional to the difference between rotor inlet and exit swirl velocities:

$$Q = \frac{\dot{m}\, D_m}{2g_c}\,(V_{u_1} - V_{u_2}) \ . \qquad (28)$$

Three sets of velocity diagrams shown in Figure 26 include:

1. Case 1 - Positive rotor tip speed; $U = 200$, $Q = Q_1$
2. Case 2 - Zero rotor tip speed; $U = 0$, $Q = Q_2$
3. Case 3 - Negative rotor tip speed; $U = -200$, $Q = Q_3$.

Since the stator angle α_1 is constant, the rotor inlet swirl vector (V_{u_1}) has the same magnitude in all three cases. However, the magnitude of the rotor exit swirl vector V_{u_2} increases as rotor tip speed decreases. For the velocity diagrams in this example, the rotor torque increases by a factor of 1.33 as tip speed decreases from $U = 200$ to $U = 0$:

$$\frac{Q_2}{Q_1} = \frac{400 - (-400)}{400 - (-200)} = 1.33 \ ,$$

and rotor torque when $U = -200$ is 1.66 times the rotor torque when $U = 200$. Thus the torque-versus-speed characteristic obtained is linear.

Using this approach, the torque-versus-speed characteristic was determined for each of the reverse-turbine designs described in Table 3. The results shown in Figure 27 indicate that conservative ship-stopping distances should be obtained when torque of the reverse turbine is assumed to be constant. In actuality, the astern torque could be as much as 20% higher at times during the simulated crash reversal. Repeating crash

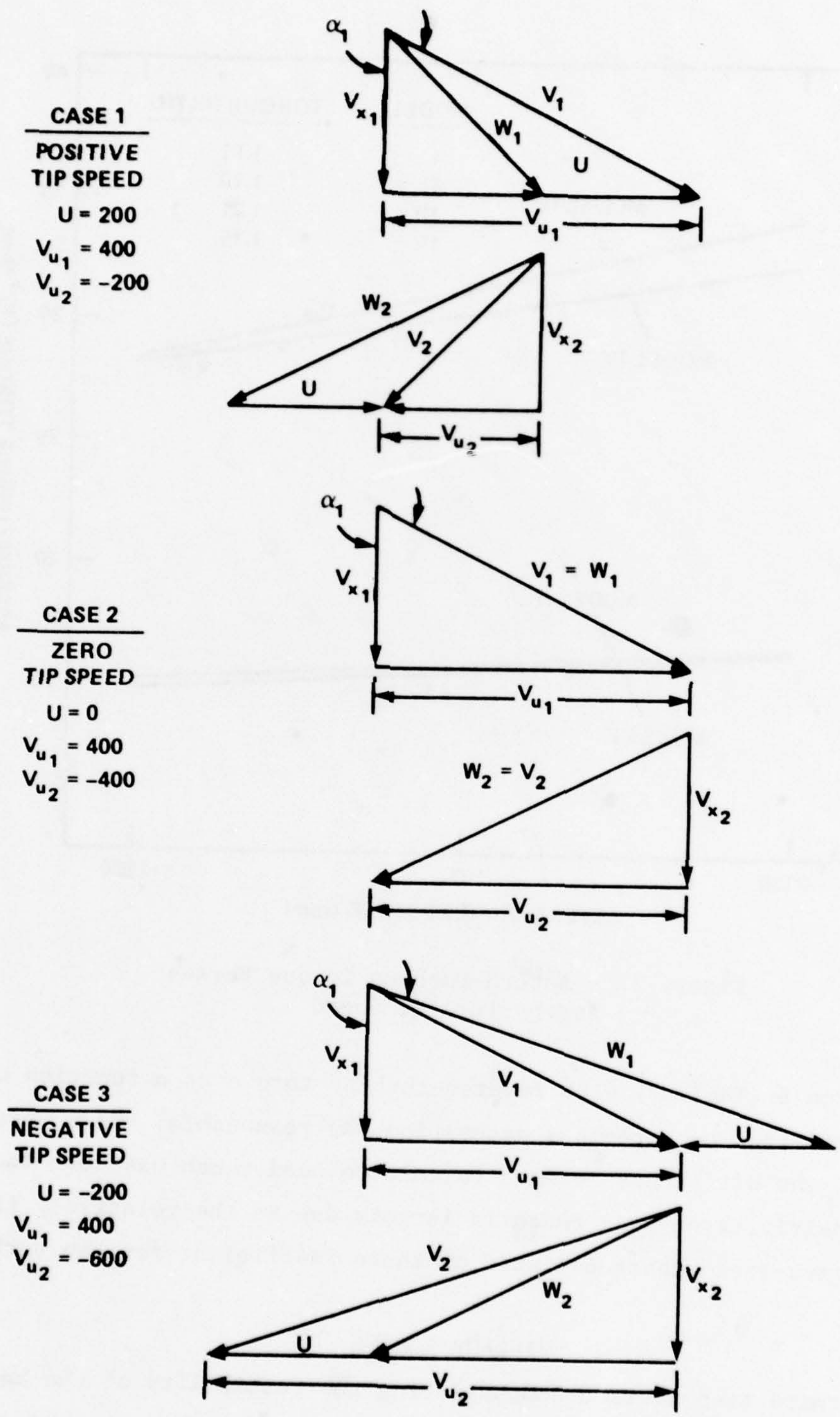


Figure 26 - Velocity Diagrams of a Turbine Stage

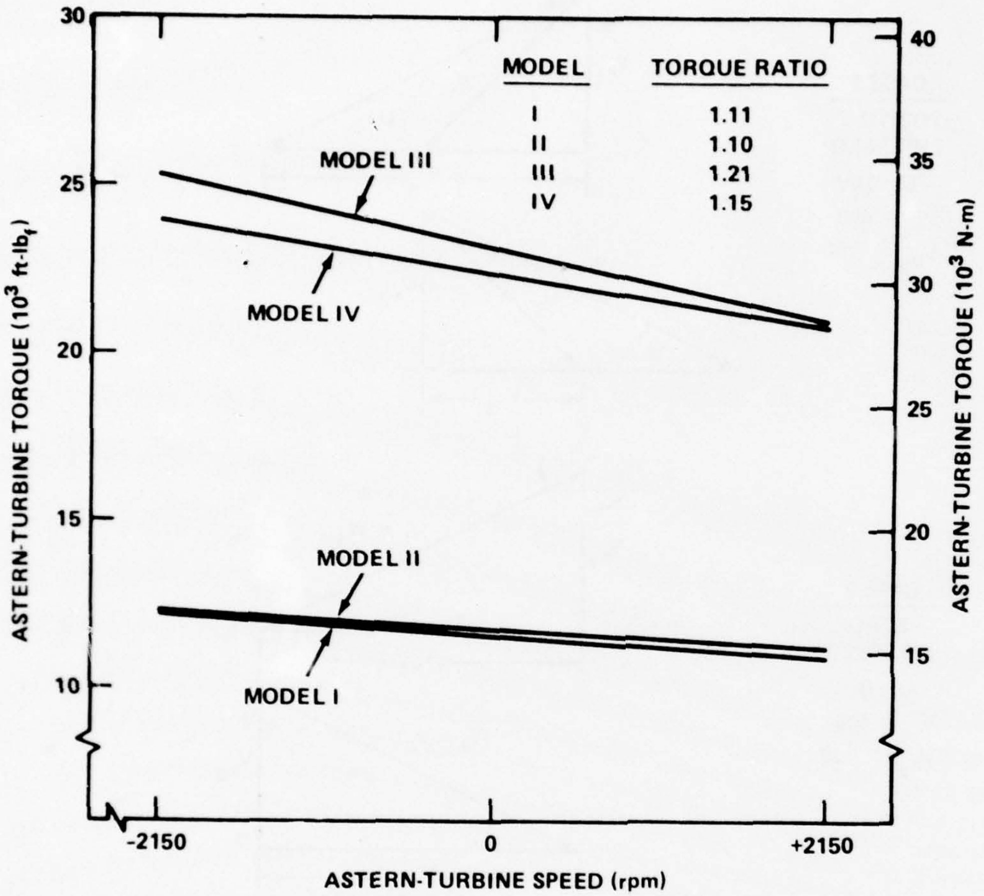


Figure 27 - Astern-Turbine Torque Versus Astern-Turbine Speed

reversal Run 6 (Table 2) with reverse-turbine torque as a function of speed demonstrated that our previous assumption was reasonable. In a worst-case situation, the difference between calculated head reach was less than 4%. This insensitivity of head reach is largely due to the relatively flat torque-versus-speed characteristic of these inefficient reverse turbines.

WINDAGE LOSSES

The third step towards demonstrating the feasibility of the hard-coupled, isolated, reverse-turbine system involved estimating the backwards-rotation windage loss for each of the four alternative reverse-

turbine designs. For the particular arrangement referred to here as the "isolated reverse-turbine system," several turbine windage losses have a significant impact on the feasibility of the system. In defining the reverse-turbine power requirement, windage loss of the backwards-spinning ahead turbine must be considered in addition to the crash reversal torque requirements of the ship. By minimizing the ahead-turbine windage, the size of the reverse turbine is kept small. Since the isolated reverse turbine is mounted on the engine's output shaft, it rotates backwards during operation of the ahead turbine, and its windage loss represents a penalty on the ahead turbine's performance. A clutch could be included in the system if a significant penalty on ahead-turbine performance is incurred, but the cost and complexity of the system would be increased. Thus, the attractiveness of this reversing system depends largely upon minimizing the windage losses of both the ahead and reverse turbines. This section of the report summarizes existing empirical correlations for windage loss of turbine rotors, discusses the reverse-turbine windage loss calculations, and also gives the estimated windage loss for the ahead turbine when running in reverse.

TURBINE ROTOR WINDAGE

The power required to spin a turbine rotor under conditions of no through flow is referred to as windage or rotation losses. Mathematical expressions for windage loss are usually given as a function of mean blade speed, blade height, mean rotor diameter, and ambient density. A proportioanlity constant is included to account for other variables such as direction of rotation (forward or backward), turbine configuration upstream and downstream from the rotor, blade aspect ratio, Reynolds number, and Mach number. A literature search for turbine rotor windage information uncovered references dating as far back as the early 1900's. In a classic steam turbine text, Stodola[6] published the results from a series of experiments he conducted to "clear up the questions" stemming from these earliest windage loss studies. A smooth disk measuring 0.157 in. (0.399 cm) thick and 21.14 in. (53.7 cm) in diameter, and five turbine rotors with tip diameters ranging from 21.46 to 49.8 in. (54.5 to 126.5 cm) were tested by Stodola. Details pertaining to the geometry of these five

rotors are given in Table 4. The two test configurations included a single rotor running in either free (open) air or in an enclosure designed to prevent the circulation of surrounding air. The windage loss for backward as well as forward running was determined for a number of the rotors.

TABLE 4 - ROTORS USED IN STODOLA'S WINDAGE TESTS[6]

Turbine Rotor	Tip Diameter in. (cm)	Blade Height in. (cm)	Blade Width in. (cm)	Mean Diameter in. (cm)	Ratio of Blade Height to Mean Diameter
A	21.457 (54.5)	0.787 (2.00)	0.787 (2.00)	20.670 (52.5)	0.038
B	24.567 (62.4)	2.362 (6.00)	0.787 (2.00)	22.205 (56.4)	0.106
C	28.425 (72.2)	0.965 (2.45)	0.787 (2.00)	27.460 (69.75)	0.035
D	37.008 (94.0)	1.083 (2.75)	0.984 (2.50)	35.925 (91.25)	0.030
E	49.803 (126.5)	2.165 (5.50)	0.984 (2.50)	47.638 (121.0)	0.045

The results of Stodola's windage tests are summarized in Table 5. Based on these results, several conclusions were drawn:

1. Windage loss of disks or rotors increases approximately as the third power of rotational speed.

2. A rotor running in free air has a considerably higher windage loss than the same rotor running in an enclosure.

3. For rough comparison of results, the following empirical formula is used:

$$WL = \frac{\beta}{10^6} \cdot D_t^{\,2} \cdot \rho \cdot U_t^{\,3} \qquad (29)$$

where D_t = tip diameter (ft), U_t = tip speed (fps), and WL is measured in hp. In these experiments the density ρ of the surrounding gas was 0.0700 lb_m/ft^3.

4. Windage loss of an open rotor running backwards is 5 to 6 times as great as running it forwards.

5. Windage loss of an enclosed rotor running backwards is only 1.2 times as great as running it forwards.

6. Enclosing the rotor blades alone eliminates most of the windage loss, and very little improvement is gained by enclosing the entire rotor (disk and blades).

More recent and more comprehensive tests on rotor windage losses have been reported by Suter and Traupel.[7] Their data are more useful than data from other sources, because rotors from modern turbines were tested by a systematic variation of the geometrical configuration. As shown in Table 6, a total of 11 rotor configurations were tested, including 8 single-stage and 3 two-stage arrangements. The test apparatus consisted of a wheel having a hub diameter of approximately 23 in. (59 cm). Blades of varying height and axial chord were attached to the wheel. The smallest to the largest blade height ranged from 1.0 to 3.4 in. (2.5 to 8.6 cm). A narrow series and a wide series of blades, having axial chords 1 and 2 in. (2.45 and 4.9 cm), respectively, were tested. The forward and reverse rotational speed of the wheel could be varied between 500 and 3200 rpm. The results obtained during these windage tests were used to determine values for the coefficient C in the following equation:

$$WL = \frac{c}{k_p} \frac{\pi}{2} D_m \ell \frac{\rho}{g_c} U_m^3 \quad . \tag{30}$$

For each rotor arrangement, the value of this coefficient was plotted as a function of blade height-to-mean diameter ratio for these conditions:

1. Forward rotation of the narrow series of blades
2. Backward rotation of the narrow series of blades
3. Forward rotation of the wide series of blades
4. Backward rotation of the wide series of blades.

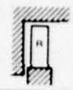
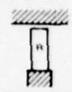
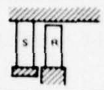
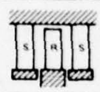
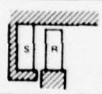
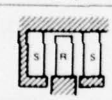
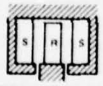
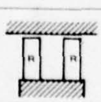
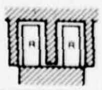
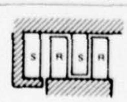
TABLE 5 - STODOLA'S WINDAGE TEST RESULTS[6]

Test	Test Conditions	Direction of Rotation	Max rpm	Tip Speed fps (m/s)	Windage Loss hp (kW)	β*
1	Smooth disk, open	Forward	2000	184.7 (56.3)	0.147 (0.110)	0.265
2	Rotor A, open	Forward	2200	206.0 (62.8)	0.536 (0.400)	0.265
3	Rotor A, open	Backward	2100	196.5 (59.9)	2.518 (1.878)	1.432
4	Rotor A, enclosed	Forward	2200	206.0 (62.8)	0.292 (0.218)	0.145
5	Rotor B, open	Forward	2100	225.1 (68.6)	1.849 (1.379)	0.535
6	Rotor B, enclosed	Forward	2100	225.1 (68.6)	0.704 (0.524)	0.203
7	Rotor B, enclosed	Backward	2200	235.9 (71.9)	0.912 (0.680)	0.229
8	Rotor C, open	Forward	2200	273.0 (83.2)	1.762 (1.314)	0.213
9	Rotor D, open	Forward	1650	258.2 (78.7)	2.303 (1.718)	0.194
10	Rotor D, open	Backward	750	121.1 (36.9)	1.501 (1.120)	0.389
11	Rotor E, open	Forward	980	213.0 (64.9)	2.894 (2.159)	0.240
12	Rotor E**	Forward	1650	358.6 (109.3)	3.850 (2.872)	0.067
13	Rotor E**	Backward	1400	304.1 (92.7)	3.068 (2.289)	0.087
14	Rotor E, enclosed	Forward	1400	304.1 (92.7)	2.130 (1.589)	0.620

*Coefficient for U.S. Customary Units only.

**Outer 6.3 in. (16.0 cm) of rotor enclosed rather than the entire wheel.

TABLE 6 - SUMMARY OF SUTER AND TRAUPEL[7] WINDAGE TEST RESULTS

Test Arrangement		Arrangement Description	Values* of C		Windage Loss,** hp (kW)	
			Rotation			
			Forward	Backward	Forward	Backward
		Single-Stage Rotor				
	a-a	Covered upstream and downstream	0.022	0.025	1.98 (1.48)	2.25 (1.68)
	a-f	Covered upstream and free downstream	0.060	0.190	5.39 (4.02)	17.08 (12.74)
	f-f	Free upstream and downstream	0.093	0.680	8.36 (6.24)	61.13 (45.60)
	o-f	Open stator upstream and free downstream	0.067	0.530	6.02 (4.49)	47.65 (35.50)
	o-o	Open stator upstream and downstream	0.063	0.500	5.66 (4.22)	44.95 (33.50)
	g-f	Enclosed stator upstream and free downstream	0.073	0.450	6.56 (4.89)	40.46 (30.20)
	g-o	Enclosed stator upstream and open stator downstream	0.063	0.450	5.66 (4.22)	40.46 (30.18)
	g-g	Enclosed stators upstream and downstream	0.063	0.450	5.66 (4.22)	40.46 (30.18)
		Two-Stage Rotor				
	2-a	Free upstream and downstream	0.130	0.952	11.69 (8.72)	85.58 (63.84)
	2-b	Covered upstream and downstream of both rotors	0.044	0.050	3.96 (2.95)	4.50 (3.36)
	2-c	Enclosed stator upstream, stator located between rotors, and free downstream	0.135	0.720	12.14 (9.06)	64.73 (48.29)

*Values given correspond to a (b/D_m) ratio = 0.038 and (ℓ/D_m) ratio = 0.12; values are applicable to both U.S. Customary and metric system of units.

**Windage loss is calculated using Equation (30) for a rotor having a mean diameter D_m = 30 in. and speed = 2000 rpm (U_m = 262 fps). Density of the surrounding air is assumed to be 0.075 lb/ft^3.

$$WL\ (hp) = \frac{1}{550}\, C\, \frac{\pi}{2}\, D_m\, \ell\, \frac{\rho}{g_c}\, U_m^{\ 3} = \frac{3.1416}{550(2)}\ \frac{30}{12}\ \frac{3.6}{12}\ \frac{0.075}{32.14}\ (262)^3 = 89.9 \times C$$

As an example, the coefficients for a narrow blade having $\ell/D_m = 0.12$ were used to calculate the windage loss of a 30-in. (76.2-cm) rotor running both forwards and backwards at 2000 rpm. The values of the coefficient and the corresponding windage loss are given in Table 6. In general, Suter and Traupel's results support the conclusions drawn from Stodola's work done at least 30 years earlier. The variety of rotor configurations studied by Suter and Traupel provide additional insights into windage losses:

1. The ideal method for minimizing windage loss is to completely enclose the rotor, but this arrangement may be difficult to attain within an engine.

2. Blockage of one side of a single-stage rotor (arrangement a-f) greatly reduces its "open-air" windage loss, particularly if rotated backwards.

3. Even the presence of a stator upstream (arrangement 0-f) decreases windage loss by 25% and an added stator downstream of the rotor (arrangement o-o) further reduces the windage loss.

4. Blockage upstream from the first stator in a single- or two-stage rotor can reduce windage loss during backward rotation by as much as one third that of the free rotor.

The General Electric Company, while designing the GE-MARAD "piggyback-bucket" direct-reversing turbine, recognized the importance of the windage loss of the astern element during ahead operations. A lack of both theoretical analysis and pertinent test data prompted General Electric to conduct a series of special windage tests in 1963.[8] As shown in Table 7, five different arrangements were tested. Windage loss was measured for each arrangement running at forward and backward speeds between 2400 and 3600 rpm. The following empirical formula was used to fit the test results:

$$WL\ (hp) = k\,\rho \left(\frac{U_m}{100}\right)^3 A_a \qquad (31)$$

where

A_a = turbine exit annulus area (in^2)

U_m = mean blade speed (fps)

ρ = density of surrounding fluid (lb_m/ft^3).

As an example, the coefficients for a narrow blade having $\ell/D_m = 0.12$ were used to calculate the windage loss of a 30-in. (76.2-cm) rotor running both forwards and backwards at 2000 rpm. The values of the coefficient and the corresponding windage loss are given in Table 6. In general, Suter and Traupel's results support the conclusions drawn from Stodola's work done at least 30 years earlier. The variety of rotor configurations studied by Suter and Traupel provide additional insights into windage losses:

1. The ideal method for minimizing windage loss is to completely enclose the rotor, but this arrangement may be difficult to attain within an engine.

2. Blockage of one side of a single-stage rotor (arrangement a-f) greatly reduces its "open-air" windage loss, particularly if rotated backwards.

3. Even the presence of a stator upstream (arrangement O-f) decreases windage loss by 25% and an added stator downstream of the rotor (arrangement o-o) further reduces the windage loss.

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$$\text{WL (hp)} = k\,\rho \left(\frac{U_m}{100}\right)^3 A_a \qquad (31)$$

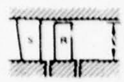
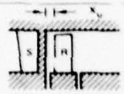
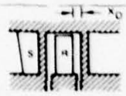
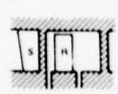
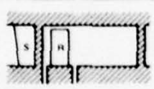
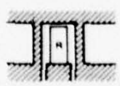
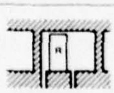
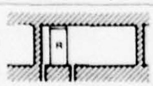
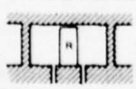
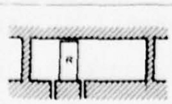
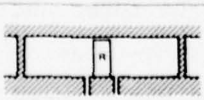
where

A_a = turbine exit annulus area (in^2)

U_m = mean blade speed (fps)

ρ = density of surrounding fluid (lb_m/ft^3).

TABLE 7 - SUMMARY OF GE-MARAD WINDAGE TEST RESULTS

Test Arrangement		D_m in. (cm)	$\frac{\ell}{D_m}$	X_u in. (cm)	X_D in. (cm)	Values*** of k Rotation Forward	Backward	$\frac{k_B}{k_F}$
* 	A	23.7 (60.2)	0.091	Stator upstream	Open downstream	9.12×10^{-3}	114×10^{-3}	12.5
* 	B	23.7 (60.2)	0.091	0.323 (0.82)	Open downstream	6.97×10^{-3}	26.8×10^{-3}	3.84
* 	C	23.7 (60.2)	0.091	0.323 (0.82)	0.925 (2.35)	2.57×10^{-3}	3.07×10^{-3}	1.19
* 	D	23.7 (60.2)	0.091	0.323 (0.82)	3.225 (8.19)	3.15×10^{-3}	4.87×10^{-3}	1.55
* 	E	23.7 (60.2)	0.091	0.323 (0.82)	5.590 (14.2)	3.99×10^{-3}	6.34×10^{-3}	1.59
** 	I-A	33.8 (85.8)	0.129	0	0	3.88×10^{-3}	3.88×10^{-3}	1.00
** 	I-B	33.8 (85.8)	0.129	0	2 (5.08)	-	4.63×10^{-3}	-
** 	I-C	33.8 (85.8)	0.129	0	3.9 (9.9)	4.85×10^{-3}	5.10×10^{-3}	1.05
** 	II-A	33.8 (85.8)	0.129	2 (5.08)	2 (5.08)	-	5.40×10^{-3}	-
** 	II-B	33.8 (85.8)	0.129	2 (5.08)	3.9 (9.9)	5.32×10^{-3}	5.77×10^{-3}	1.08
** 	III-A	33.8 (85.8)	0.129	3.9 (9.9)	3.9 (9.9)	6.01×10^{-3}	6.19×10^{-3}	1.03

*1963 windage tests conducted by General Electric Company for Maritime Administration, Government Contract MA-3000.[8]

**1972 windage tests of General Electric's direct-reversing turbine rotor for Maritime Administration, Government Contract 0-35510.[1]

***Applicable to U.S. Customary units only.

The similarity between Equations (30) and (31) is easily shown by defining the exit annulus as

$$A_a = \frac{144\pi\left[D_t^{\;2} - D_h^{\;2}\right]}{4}$$

$$= \frac{144\pi\left[(D_m + \ell)^2 - (D_m - \ell)^2\right]}{4}$$

$$= 144\pi\ D_m\ \ell \qquad (32)$$

and substituting this expression into Equation (31) to obtain

$$WL\ (hp) = 144k\ \pi\ D_m\ \ell\ \rho\left(\frac{U_m}{100}\right)^3 . \qquad (33)$$

The mean diameter D_m and blade height ℓ are in feet. Again in 1972, "no-leak" windage experiments were conducted[1] for the particular astern airfoil geometry used in General Electric's direct-reversing turbine. As shown in Table 7, six configurations were tested using the same rotor but varying the axial spacing between the rotor and its upstream/downstream enclosures. The results of these windage tests can be described by Equation (33) also. The magnitude of the proportionality constant k is given for each arrangement running forward and backward. The results obtained by General Electric show trends similar to those reported by Suter and Traupel. Arrangement A in Table 7 is comparable to arrangement o-f in Table 6. Based on Suter and Traupel's results, the windage loss of a rotor arrangement like o-f having a mean diameter = 30 in. (76.2 cm), an $\ell/D_m = 0.12$, and a mean blade speed = 262 fps (79.86 m/s) is 6.02 hp (4.49 kW) running forward and 47.65 hp (35.55 kW) running backward (see Table 6). If the windage loss calculation for this same rotor is based on General Electric's data, the result is 4.17 hp (3.11 kW) running forward and 52.17 hp (38.92 kW) running backward. Thus, both studies agree that the pumping action of an open rotor running backward produces intolerable windage losses. Arrangement B

in Table 7 is comparable to arrangement a-f in Table 6. Forward and backward windage losses for arrangement a-f are 5.39 and 17.08 hp (4.02 and 12.74 kW), respectively. Comparable values of windage loss for Arrangement B are 3.19 hp (2.38 kW) running forward and 17.24 hp (9.13 kW) running backward. Thus, both studies agree that the pumping action of the rotor can be significantly reduced by blocking one side of the rotor. The GE-MARAD test results for the remaining arrangements show the effect that axial distance between rotor and enclosures has on windage loss. Figure 28 is a plot of windage loss coefficient versus sum of the upstream and downstream distances. The results also show that windage of one rotor (1963 data) may be more sensitive to the sum of distances than another rotor (1972 data). Thus, to be safe the distance between rotor and enclosures should be kept to a minimum.

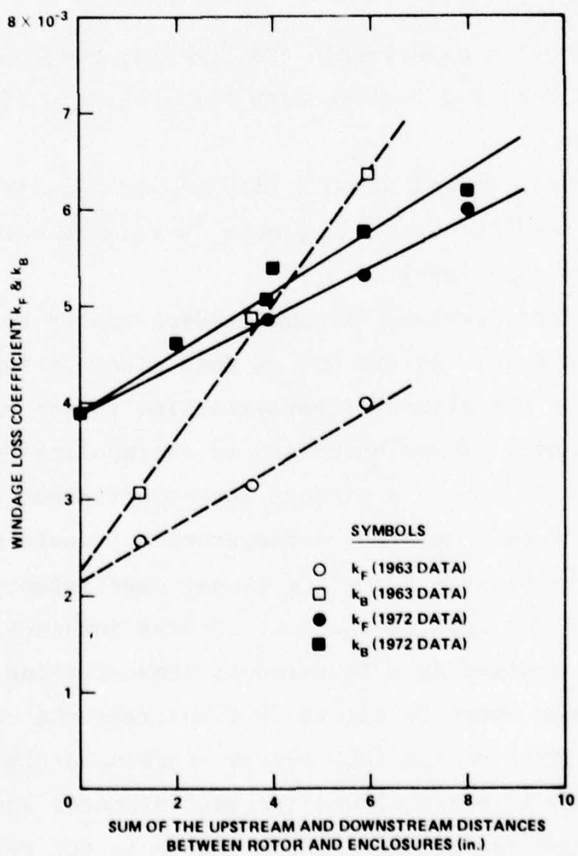


Figure 28 - Windage Loss Coefficients k_F and k_B Versus Sum of the Upstream and Downstream Distances Between Rotor and Enclosures

In summary, this discussion of turbine rotor windage studies has served several useful purposes:

1. It has shown that the geometry of a rotor and its surroundings have a significant effect on the magnitude of the windage loss.

2. It has suggested through comparisons of empirical results, ways to design for minimum windage loss.

3. It has provided a basis for estimating the windage loss of the isolated reverse turbine.

REVERSE-TURBINE WINDAGE

After analyzing the windage loss data of Stodola, Suter and Traupel, and General Electric, it was decided to base the reverse-turbine windage calculations on Suter and Traupel's empirical results. There were three reasons for this selection:

1. Suter and Traupel's experiments are the most comprehensive single source of windage loss data and include data for a variety of test arrangements and blade geometries.

2. Suter and Traupel looked at both single- and two-stage rotors.

3. Predictions based on Suter and Traupel's results were the most conservative (higher windage loss).

Unfortunately, none of the previous windage studies tested rotors with an ℓ/D_m ratio greater than 0.13. As the design data given in Table 3 indicates, the ℓ/D_m ratio of the various reverse-turbine rotors varies from 0.145 to 0.666. Therefore, it was necessary to extrapolate Suter and Traupel's data in order to obtain a windage loss coefficient in this high ℓ/D_m region. It was assumed that test arrangement a-f would most resemble the two-stage reverse turbines. Using the proper coefficient and dimensions, the windage loss for each of the four reverse turbines was calculated. The results were plotted as a function of ahead-turbine speed (see Figure 29). The drawings shown in Figure 29 illustrate the relative hub diameters and blade heights of the four reverse-turbine designs. Axial dimensions are not drawn to scale. Since the mean diameter and mean blade speed are lower, the combined windage of the rotors in the two-stage turbines is less than the windage of a single-stage turbine having the same output power. The lower penalty on ahead-turbine performance due to

reduced windage loss must be weighed against the added length, weight, cost, and complexity of the two-stage reverse turbine. Also, the small exit hub diameter of the two-stage turbines may not be compatible with the diameter of the engine output shaft. The results do show that as one strives for shorter ship-stopping distances, the reverse turbine must get larger, and as the reverse turbine grows in size, its windage loss increases exponentially. If the isolated reverse turbine is to have minimal effect on ahead-turbine performance, it must be sized for the maximum allowable ship-stopping distance.

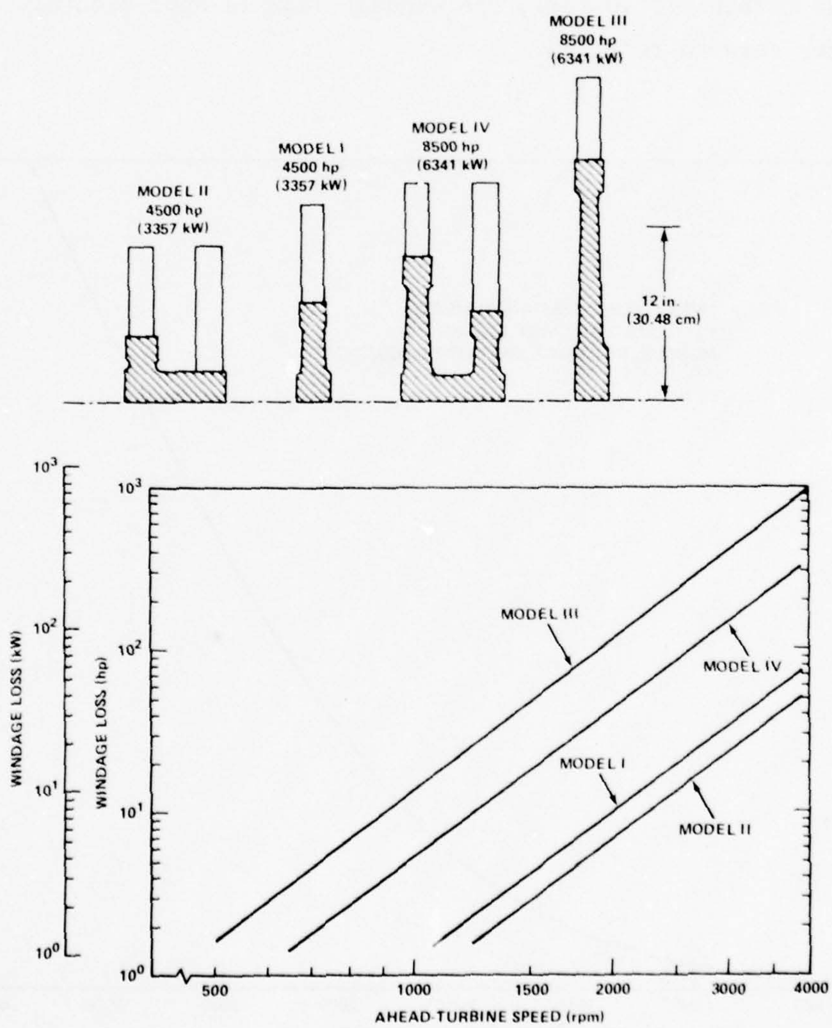


Figure 29 - Reverse-Turbine Windage Loss
Versus Ahead-Turbine Speed

AHEAD-TURBINE WINDAGE

To properly size the reverse turbine, the windage loss of the ahead turbine running backwards and the crash-reversal torque requirements of the ship must be considered together. In this case the ahead turbine is the six-stage, low-pressure turbine in the LM2500 marine gas turbine. The empirical results given earlier do not apply to a six-stage turbine. However, a curve was found in the literature[9] which gives the estimated "no-leak" windage losses for the LM2500 low-pressure turbine running forward. That curve is reproduced here as Figure 30. Note that at the design speed of the reverse turbine (2150 rpm), the windage loss is approximately 700 hp (522 kW) for forward rotation.

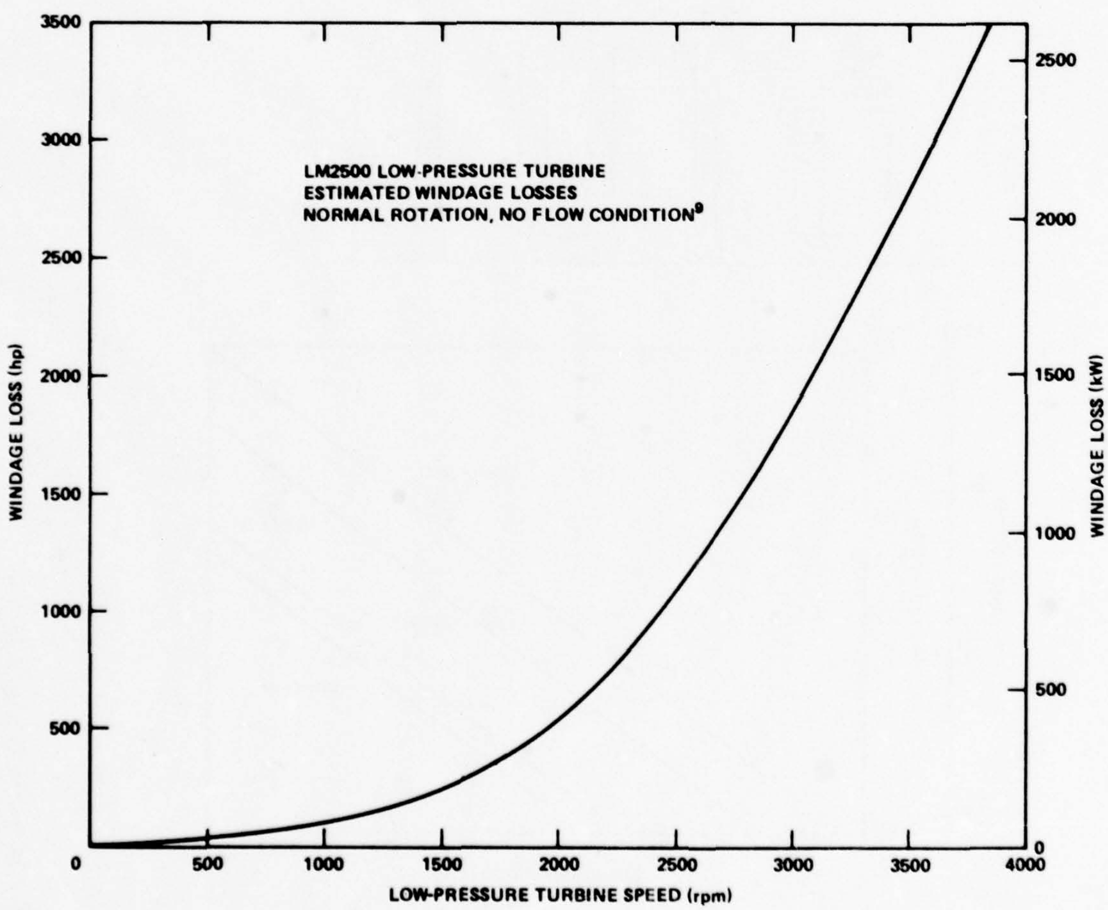


Figure 30 - Ahead-Turbine Windage Loss
Versus Ahead-Turbine Speed

The curve also makes a strong case for having a low-speed reverse turbine. The windage loss for backward rotation will be higher. How much higher depends on which set of empirical data the estimate is based. The results plotted in Figure 28 have shown that the backwards rotation loss can be 1.0 to 1.6 times the forward rotation loss. The empirical results of Stodola and others also imply that the windage loss of the LM2500 low-pressure turbine would be reduced by enclosing it as in the isolated reverse-turbine arrangement. Thus, in determining the astern-turbine power requirement, windage loss of the ahead turbine was assumed to be 500 hp (373 kW) for enclosed, backwards rotation at 2150 rpm. The ahead-turbine windage loss represents 11% of the output power of reverse-turbine Models I and II, and represents 5.8% of the output power of reverse-turbine Models III and IV. An ahead-turbine designed for minimum windage loss during astern-turbine operation would have less impact on the size of the reverse turbine than the six-stage LM2500 power turbine.

DISCUSSION

This report, through dynamic analysis of ship-stopping requirements and utilization of an existing axial-flow preliminary design computer program, provides turbine size and performance characteristics for application to an isolated reverse-turbine system. The system considered can be adapted to the exhaust elbows and output shafts of existing marine gas turbine engines and employed for crash reversal, maneuvering, and backing of gas-turbine-driven ships. The analysis technique provides tradeoff information which allows the designer to quantify the relationships between ship-stopping capability, windage penalty, and reverse-turbine complexity. The final design of a hard-coupled, isolated, reverse-turbine system represents a compromise between major factors which have a direct impact on the overall feasibility of the system. During this study, these factors have been identified as:

1. head reach requirement
2. level of astern torque
3. activation time for the reverse turbine
4. losses in ahead performance
5. cost and complexity.

It is desirable to design for maximum allowable head reach in order to minimize astern-turbine torque requirement. As important, a finite activation time for the reverse turbine imposes a minimum level of astern-turbine torque needed to meet a given head reach. By minimizing astern-torque and/or activation time, a small reverse turbine with negligible losses in ahead performance can achieve reasonable ship-stopping goals. The advantages of a clutch for disengaging the reverse turbine during ahead operation do not justify the additional cost and complexity over a reverse turbine which is hard-coupled to the ahead-turbine shaft.

The dynamic analysis considered stopping a 3600-ton ship driven at 30 knots by a five-bladed, fixed-pitch propeller. Stopping the ship consisted of dropping the positive torque off the shaft and introducing the negative torque of the reverse turbine to the shaft over a period of time. Various torque levels and time lags were examined parametrically.

The ship type, drag relationships, and propeller type considered are typical of Navy displacement-type ships. The propeller selection was limited to those for which four-quadrant thrust coefficient and torque coefficient data are available. For the dynamic computer modeling, it was necessary to compile the propeller thrust and torque characteristics as functions of a second modified advance ratio. The dynamic analysis consisted of the solution of two dynamic equations, one describing the motion of the ship (thrust, drag, ship mass, and deceleration), and one describing the motion of the shaft (torque, friction, inertia, and deceleration/acceleration). These two equations are linked through the propeller characteristics. In the dynamic analysis, the windage losses of the ahead and the astern turbines are not included in the torque balance. During the first stage of the crashback maneuver, windage of the astern turbine helps to decelerate the drive train while ahead-turbine power is chopped. During later stages of the crashback maneuver, ahead-turbine windage reduces the astern-turbine torque that would be available if the ahead turbine were disengaged. The two separate effects have a tendency to cancel each other out. The assumption that astern-turbine torque is constant during the final period of the crashback maneuver is not completely accurate either. Since rotor torque is proportional to the

difference between rotor inlet and exit swirl velocities, astern-turbine torque varies linearly with speed for a given mass flow rate. The torque of an ideal impulse stage doubles as speed is decreased from positive to negative design speed. For the inefficient reverse turbines in Table 3, torque increases by only 10% to 20%. Conservative ship-stopping distances are obtained by assuming that astern-turbine torque is constant. However, the difference between the resulting head reach is less than 4%. Actually, the lower torque levels and inefficient reverse turbines are desirable since they impose no additional torque limiting control constraints on the gas turbine engine.

A modified Newton-Raphson convergence technique was employed in the dynamic analysis and proved to be economical and accurate. Typically, a 100-s crash reversal transient was analyzed in 0.1-s time increments (to a convergence tolerance of 0.001) in 25 s of computer execution time, at a cost of about $5.

The stopping distance of the ship is sensitive to both reverse-turbine torque level and the time lag involved in applying the reverse-turbine torque to the shaft. Reverse-turbine torque levels ranging from one-third up to full-ahead turbine torque were examined. The time lag accounts for chopping the fuel to the engine, activating the inlet valve mechanism, diverting the gas generator flow to the reverse turbine, and bringing the gas generator back up to full power. Time lags of 25 and 12.5 s are considered. Based on previous engine dynamics work, time lags below 10 s are probably not feasible, since 10 s would be needed to decelerate and reaccelerate the gas generator. As shown in Figure 31, reducing this time lag to a minimum is important because large time lags penalize the stopping capability at a given reverse-torque level. Over the range of head reaches of interest (3.5 to 5 ship lengths), head reach is increased on the order of 10% to 15% when the time lag increases from 12.5 to 25 s. From the standpoint of torque, if a head reach of 3.5 ship lengths is required, it can be obtained with a reverse turbine providing two-thirds of full-ahead torque at a 12.5-s time lag. If, however, a 25-s time lag exists, the reverse turbine must be sized to produce full-ahead torque. Thus, the relationship of the reverse-turbine torque requirement to the head reach requirement is detrimentally sensitive to increasing time lags,

and the importance of minimizing time lag is evident. Detailed control system analysis of the isolated reverse-turbine system is necessary in order to establish the minimum time lag.

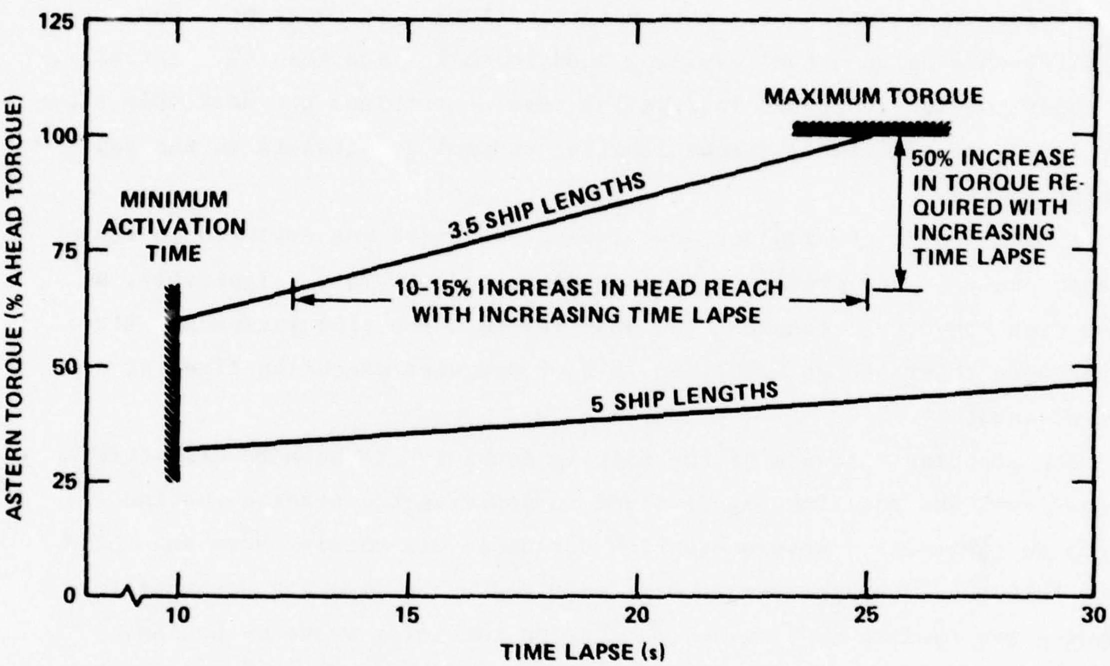


Figure 31 - Astern-Turbine Torque Versus Time Lapse

Four specific reverse-turbine designs were considered. They covered the 3.5 and 5 ship length head reach cases with both single- and two-stage turbine designs. The 12.5-s time lag (time required to drop the ahead torque from the shaft and replace it with full-astern torque) was employed as an attainable goal for the isolated reverse-turbine system of interest. A turbine design speed of 2150 rpm was selected for all designs based on the cumulative results of the various dynamic crashback simulations. It is interesting to note that this design speed, determined from crashback dynamics, will provide approximately 15 knots of steady-state astern speed (one half of maximum ahead speed), which is frequently the rule-of-thumb backing speed requirement of naval ships. If the system time

lag were to double (i.e., approach 25 s), then the reverse-turbine design speed would be about 2600 rpm and the steady-state backing speed capability would be 18 knots.

The resulting windage of the various designs is really the yardstick which determines the feasibility of the isolated reverse-turbine system, at least as far as the turbine itself is concerned. Recall that CRP propeller power penalties (due to added appendage drag) may be as much as 10%. A previous[1] integrated reverse-turbine design system was characterized by an ahead-power penalty on the order of 10%.

In order to make windage estimates of the four designs it was necessary to extrapolate existing experimental data of a similar arrangement. For a naval displacement ship, the ahead-power penalty during cruise operation (approximately one-fifth installed power) is more important than at full power. Due to the typical mission profile of the study ship, about 90% of mission time is spent at ship speeds less than 21 knots. Since more time is spent at cruising speed than at any other speed, windage losses at cruise conditions are considered important. From the steady-state powering data for the study ship, ahead-turbine power is 4500 hp (3356 kW) and speed is 2250 rpm at a cruising speed of 20 knots. The windage loss of the reverse turbines spinning backwards at 2250 rpm are: 13.5 hp (10 kW) for Model I, 9 hp (6.7 kW) for Model II, 155 hp (116 kW) for Model III, and 60 hp (44.7 kW) for Model IV. For a ship-stopping requirement of 5 ship lengths, little is gained by going to a two-stage reverse turbine. The penalty on ahead performance due to the windage loss of Model I is about 0.3% of the ahead-turbine's power. The two-stage reverse turbine becomes much more attractive when ship-stopping requirement is 3.5 ship lengths. The penalty on ahead performance due to the windage loss of Model IV is about 1.3% of the ahead turbine's power. These results indicate that as one strives for shorter ship-stopping distances, the reverse turbine must get larger. As the reverse turbine grows in size, its windage loss increases greatly. If the isolated reverse turbine is to have minimal affect on ahead-turbine performance, it must be sized for the maximum allowable ship-stopping distance. For a head reach requirement of 5 ship lengths, the ahead-power penalty, during cruise and at full power, is negligible for both single- and two-stage reverse

turbines, and thus feasibility, at least for the reverse turbine, is established. In regard to a head reach requirement of 3.5 ship lengths, windage estimates indicate that a significant power loss (approximately 2.6%) at cruise occurs for a single-stage reverse turbine, but a two-stage turbine could reduce this penalty to 1.3% of ahead power.

There is still some doubt about the accuracy of the windage estimates because, although the turbine configurations tested were similar to the particular isolated reverse turbine of interest, extrapolation of the data was necessary to make the estimates. Further experimentation of the isolated reverse-turbine configuration is necessary to solidify the windage penalty associated with both the reverse turbine and the ahead turbine.

The discussion of losses in the GE-MARAD direct-reversing turbine found in the introduction supports the conclusion that most of their penalties on ahead performance are peculiar to their variable nozzle/ "piggyback" bucket arrangement. In the isolated reverse-turbine arrangement:

1. Sealing of the reverse-turbine compartment by the exhaust valve and shutoff valve should keep leakage (therefore windage loss) to a minimum.

2. Cooling the reverse turbine during ahead operation is unnecessary when located outside the hot section.

3. Modifying the ahead flow path is kept to a minimum to avoid losses.

4. Reverse-turbine diameter is kept small to minimize windage losses.

In summary, the results of this study have shown that a two-stage reverse turbine having two thirds of design ahead-turbine torque and activated in 12.5 s can achieve a stopping distance goal of 3.5 ship lengths with an associated loss in cruise ahead power of only 1.3%. These results are very encouraging and suggest that the stopping capability of the isolated reverse turbine and CRP are comparable. Further investigation of the isolated reverse-turbine system is warranted based on the positive results of the turbine analysis for the ship-stopping requirements examined. Cold flow windage tests on appropriate turbine, ducting, and valving configurations are necessary to solidify ahead-power penalty

estimates. Alternative designs of the required inlet valve mechanism should be developed. Contractor evaluation of the isolated reverse-turbine system, with emphasis on turbine design, engine interface problems with the inlet valve mechanism, and turbine exhaust elbow mounting, are a necessity.

CONCLUSIONS

This report has concentrated on the analysis of the ship-stopping requirements and the preliminary design performance characteristics of axial-flow turbines as employed in a particular isolated, reverse-turbine system. The analysis has shown that the shaft-mounted reverse turbine is a feasible component of such an isolated reverse-turbine system. Based on the analysis performed, the following conclusions are drawn:

1. The ship-stopping requirement (head reach) and the time lag associated with applying reverse torque to the shaft are the constraints which determine the reverse-turbine's size, and therefore its windage penalty in the ahead mode.

2. A moderate ship-stopping requirement (5 ship lengths) can be accomplished with a 27.5-in.-diameter (69.9-cm), single-stage, axial-flow turbine having a negligible windage penalty during ahead operation. For a more severe requirement of 3.5 ship lengths, two stages 30.5 in. (77.5 cm) in diameter are required to keep the windage penalty near 1% of the ahead power at cruising speeds.

3. The feasibility of the isolated reverse-turbine system depends on its ability to apply the specified reverse-torque level to the shaft within a time period on the order of 10 to 15 s.

4. The simple shaft-mounted turbine concept studied herein should be able to meet the conflicting requirements of short stopping distance and low ahead-windage penalty, and is therefore considered to be a viable candidate for the maneuvering of gas-turbine-powered ships employing either mechanical or electrical transmissions.

RECOMMENDATIONS

The results obtained from the analysis tend to support the feasibility of the isolated reverse-turbine system. However, many important questions remain unanswered, some of which require detailed designs and testing of components. The reliability of the system must be considered, as well as the development cost and technical risk. The concept should be studied further for potential use by the Merchant Marine as well as the U.S. Navy.

In regard to the turbine, the following recommendations are made:

1. Cold flow windage tests on a representative turbine configuration should be performed in order to solidify ahead-power penalty estimates.

2. A detailed turbine design, including inlet scroll and exit valve, should be performed by an experienced gas turbine engine manufacturer. Also, the design details of mounting the reverse turbine on the output shaft, integrally with the exhaust elbow, should be determined.

In regard to the inlet valve mechanism, it is recommended that:

1. Various concepts be examined. A model of the most attractive inlet valve mechanism be designed, built, and tested at representative conditions to demonstrate its mechanical feasibility, to obtain flow proportioning characteristics of the valve as a function of position, and to provide information for improvements necessary in specifying the valve.

2. A gas turbine engine manufacturer investigate the feasibility of incorporating the mechanism between the gas generator and free power turbine of an existing engine.

It is recommended that these technical issues be addressed at the feasibility model level. Any full-scale development should await the results of current Navy programs intended to show the benefits of alternate mechanical or electrical approaches to reversing.

ACKNOWLEDGMENT

The author wishes to acknowledge the contributions made by Mr. Samuel R. Shank, Jr. of the Gas Turbines Branch, David W. Taylor Naval Ship Research and Development Center. His guidance and assistance during this investigation is greatly appreciated.

APPENDIX A

PATENT APPLICATION

"Isolated Reverse-Turbine System for Gas Turbine Engines"
Inventors: Samuel R. Shank and Thomas L. Bowen

ABSTRACT OF THE DISCLOSURE

A reversing system for gas turbine engines having, in addition to a conventional gas generator and power turbine, a reversing turbine coupled to the exhaust end of the power turbine output shaft, a gas flow proportioning inlet mechanism, and a movable blocking exhaust valve. Intermediate and full-stop power settings are achieved by proportioning the gas flow between the forward and the reverse turbines, and windage losses are minimized by selectively blocking the gas flow through the turbines.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

This invention relates generally to gas turbine engines, and more particularly to a system for controllably reversing the direction of rotation of an output shaft connected thereto.

The gas turbine engine, a thermodynamic device for supplying shaft power is fundamentally unidirectional with respect to output shaft rotation. In many applications, such as ship propeller drives, it is necessary to have the capability of reversing the direction of rotation of the engine. One method employed in prior art gas turbine engines is the use of power turbine nozzles having a variable geometry. However, this necessitates compromises in the design of the power turbine nozzles and vanes, thus reducing the engine fuel economy during normal operation. Another method involves a separate reversing turbine mounted concentrically within the power turbine. Fuel economy is also sacrificed with this method because of the necessary design compromises in the power turbine inlet passages. Other ship reversing systems have included controllable-pitch propellers with their attendant disadvantages of added cost, weight, complexity, and increased appendage drag.

SUMMARY OF THE INVENTION

Accordingly, the present invention overcomes many of the disadvantages of prior art gas turbine reversing methods by providing a system that minimized losses during normal, i.e., forward mode, operation and is suitable for use with fixed-pitch propellers.

According to one embodiment of the present invention, a reverse turbine is mounted on the output shaft of a conventional gas turbine engine. An inlet valve mechanism is mounted between the gas generator and the power turbine and includes a plurality of radially movable diverter blocks, each diverter block being a segment of an annular ring. In the reverse mode of operation, the diverter blocks are moved radially inward to block the annular flow channel and divert the flow of gases from the gas generator into a collector scroll and thereafter, by means of a bypass ducting, to a reverse turbine inlet scroll. A movable exhaust valve, in the form of a conical diffuser, is positioned so as to block the exhaust end of the power turbine while allowing the gases to flow through the reverse turbine and into an exhaust elbow.

In the forward mode of operation, the diverter blocks are retracted and then sealed off by a plurality of rectangular flaps which, when closed, force the gases to flow through the power turbine. The movable conical diffuser is positioned so as to block the exhaust end of the reverse turbine. A shut-off valve in each bypass duct, in conjunction with the conical diffuser, isolates the reverse turbine and minimizes windage losses therefrom. The shut-off valves may also be used in conjunction with the diverter blocks and conical diffuser to proportion the gas flow between the turbines and thereby provide additional torque control.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide a gas turbine engine reversing system that minimizes windage losses during the forward mode of operation.

Another object of the invention is to provide a system that permits torque control by proportioning the gas flow between the forward and reverse turbines.

Still another object of the present invention is to provide a system for reversing the direction of rotation of the output shaft that is adaptable to existing gas turbine engines.

Yet another object of the present invention is to provide a gas turbine reversing system for ship propulsion applications that can be used with a fixed pitch propeller.

A further object of the present invention is to provide a reversing system in which the power and reversing turbines are mounted on a common output shaft and wherein the gas flow to either of the turbines may be selectively blocked, thereby isolating the selected turbine and minimizing losses.

A still further object of the present invention is to provide a system wherein during the full reverse mode of operation a novel inlet valve diverter mechanism directs the gas flow from the gas generator to the reverse turbine, while a conical diffuser blocks the power turbine exhaust, thereby completely isolating the power turbine.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and many of the attendant advantages of the present invention will be readily apparent as the invention becomes better understood by reference to the following detailed description with the appended claims, when considered in conjunction with the accompanying drawings, wherein:

Figure A.1 is a diagrammatic top view of the reverse turbine apparatus according to the present invention as applied to a conventional gas generator and power turbine;

Figure A.2 is a partially cut-away elevational view of the exhaust elbow portion of the present invention with the gas turbine in the forward mode of operation;

Figure A.3 is a view of the exhaust elbow portion shown in Figure A.2 with the gas turbine in the reverse mode of operation;

Figure A.4 is an enlarged cross-sectional view of one portion of the inlet valve mechanism shown in Figure A.1, showing the structure thereof in greater detail;

Figure A.4a is a perspective view of one of the diverter blocks in the inlet valve mechanism of Figure A.4, as viewed from the upstream side;

Figure A.4b is a perspective view of the diverter block shown in Figure A.4a as viewed from the downstream side;

Figure A.5 is an elevational view of the top half of the combination cam and ring gear according to the present invention, as viewed from the upstream side. Details of one of the accurate slots therein as viewed in the plane of line Va-Va is also shown.

Figure A.6 is an elevational view of the cam and ring gear shown in Figure A.5, as viewed from the downstream side;

Figure A.7 is an elevational view of the top half of the guide ring according to the present invention, as viewed from the upstream side. Details of one of the radial slots and one of the slide-ways as viewed in the plane of line VIIa-VIIa is also shown.

Figure A.8 is a diagrammatic elevational view of a portion of the reverse turbine section of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like reference numerals designate the same or corresponding parts throughout the several views, there is shown in Figure A.1 a gas turbine engine having a controllable inlet valve mechanism 10 mounted between the exhaust end of a gas generator 12 and the inlet of a power turbine 14. Inlet valve mechanism 10, which will be described in greater detail herein below, is spaced concentrically within an annular collector scroll 16 which, by means of a plurality of bypass ducts 18 during reverse operation of the engine, transfers the working fluid to an annular reverse turbine inlet scroll 20 located at the rearmost portion of the gas turbine engine. A reverse turbine 22 is located just forward of inlet scroll 20 and spaced from the exhaust end of power turbine 14, said turbines being mounted on a common output shaft 26. The back-to-back arrangement of power turbine 14 and reverse turbine 22 permits the exhaust from both turbines to be discharged into a common exhaust elbow 24. A positionable exhaust valve 28, whose operation will be described in detail below, acts as either a conical diffuser for power turbine 14 and blocking exhaust valve for reverse turbine

22 or a blocking exhaust valve for power turbine 14, depending upon whether the gas turbine engine is operating in the forward or the reverse mode. A shut-off valve 30, mounted within and spaced in the downstream portion of each bypass duct 18, may be positioned so as to restrict the flow of working fluid to reverse turbine 22. Exhaust valve 28 is used in conjunction with shut-off valve 30 to completely isolate reverse turbine 22 during forward operation of the engine. Shut-off valve 30 and exhaust valve 28 may conveniently be hydraulically or motor operated. Selective positioning of inlet valve mechanism 10, exhaust valve 28, and shut-off valves 30 permits either the proportioning of the working fluid flow, thereby balancing the torque of both turbines and stopping the rotation of output shaft 26, or the gradual increasing of the flow to one turbine or the other. thereby providing slightly unbalanced torque during forward or reverse low shaft speed operation.

Referring now to Figure A.2, a partially cut-away view of exhaust elbow 24 shows the position of exhaust valve 28 when the gas turbine engine is in the full forward mode of operation, that is, when all of the working fluid flows through power turbine 14 as indicated by the arrows 29 in the drawing. In this position exhaust valve 28 acts as a conical diffuser and radially directs the gas flow into exhaust elbow 24. Also, valve 28 blocks the exhaust end of reverse turbine 22, preventing any gas flow therethrough and minimizing windage losses therefrom.

For full reverse operation of the gas turbine engine, exhaust valve 28 is positioned as shown in Figure A.3, wherein valve 28 blocks the exhaust end of power turbine 14. The working fluid now flows from inlet scroll 20 through reverse turbine 22 and into exhaust elbow 24, as indicated by arrows 31 in the drawing. As described above, during operation of both turbines, for example, during low shaft speed operation, exhaust valve 28 is positioned so as to be spaced apart from the exhaust ends of both turbines.

Referring now to Figure A.4, wherein the exhaust end of gas generator 12 is to the left in the drawing and the inlet of power turbine 14 is to the right in the drawing, the top portion of inlet valve mechanism 10 is shown in greater detail. Working fluid from gas generator 12 flows through an annular channel 34 and, in the full forward mode, into an inlet flow area 35 of turbine 14. In the reverse mode of operation, a

plurality of diverter blocks 32, each being an annular segment of a shaped-ring and indicated by solid lines in the drawing, are moved radially inward into the annular channel 34 so that the inlet flow area 35 of power turbine 14 is closed off and the working fluid is radially diverted into collector scroll 16. In the forward mode of operation diverter blocks 32 are retracted to the position indicated by the dashed lines in the drawing. Insertion and retraction of diverter blocks 32 is controlled by a combination cam and ring gear 36 which is driven by means of a motorized gear 38. Cam and ring gear 36 is rotatably supported by a plurality of bearings 40 positioned about the inner and outer circumferences thereof. The downstream face of gear 36 is recessed and a plurality of circumferentially located teeth 41, more clearly seen in Figure A.6, are provided thereon, the teeth 41 facing radially inward and being formed so as to mesh with similar teeth on motorized gear 38. An anchor post 42 having a flared end 43 is affixed to the back of each diverter block 32, end 43 being inserted into one of a plurality of arcuate slots 44 formed into the upstream face of cam and ring gear 36. The configuration of an anchor post 42 on a typical diverter block 32 and the general shape of the diverter block can more clearly be seen by referring to Figures A.4a and b.

As best seen in Figure A.5, slots 44 have an arcuate shape so that a clockwise rotation of gear 36 moves diverter blocks 32 radially outward, and a counterclockwise rotation of gear 36 moves diverter blocks 32 radially inward. The length of slots 44 determines the radial travel of diverter blocks 32, the innermost end 45 of each slot 44 being configured so that anchor post 42 meets inner end 45 when diverter block 32 is seated on the inner wall of annular channel 34. Referring to Figure A.5, Section Va-Va, each slot 44 is beveled so as to conform to the shape of flared end 43 of anchor post 42, thereby retaining end 43 therein.

Each diverter block 32 is restricted to move only in a radial direction by means of a guide ring 46, which can more clearly be seen by referring to Figures A.7 and Section VIIa-VIIa. The anchor post 42 on each diverter block 32 slides radially up and down slot 47 as the diverter block is raised and lowered. The diverter blocks 32 on the right side of Figure A.7 are shown in the lowered position (reverse mode), while the diverter

blocks 32 on the left side of Figure A.7 are shown in the raised position (forward mode). Referring to Section VIIa-VIIa in Figure A.7, slide-ways 48 are provided on the upstream face of guide ring 46 for maintaining the stability of the diverter blocks when raised or lowered. Parallel alignment faces 49 on each diverter block 32 fit within the edges of slide-way 48.

To provide a space from which diverter blocks 32 can be inserted or retracted, the outer cylindrical wall of annular channel 34 is radially sectioned into a plurality of nearly flat rectanguiar flaps 50 which are hinged on their upstream side. When the gas turbine engine is operating in the forward mode, flaps 50 are in the position as shown by the dashed lines in the drawing, with diverter blocks 32 in the retracted position. Annular channel 34 thus becomes a continuous passage for the gas flow from gas generator 12 to power turbine 14. In the reverse mode, the flaps 50 open outwardly and permit diverter blocks 32 to move radially into annular flow channel 34. The flap operating mechanism is similar to the diverter block operating mechanism, having a combination cam and ring gear 52 driven by a motorized gear 54 and rotatably supported by a plurality of bearings 55. Each flap 50 is movably connected by means of a lever arm 62 to an anchor post 56 having a flared end 57. The flared end 57 of each anchor post 56 is inserted into one of a plurality of arcuate slots 58 formed into the downstream face of gear 52. A pair of fixed guide rails 60 (one shown) act as stabilizers and maintain a purely radial movement of anchor post 56 as gear 52 is rotated. As in gear 36, one face of cam and ring gear 52 is recessed and provided inwardly facing teeth configured to mesh with motorized gear 54. As viewed from the downstream side, a counterclockwise rotation of gear 52 moves anchor post 56 radially outward, thus opening flap 50.

There is shown in Figure A.8 one configuration of the reverse turbine section of a gas turbine engine according to the present invention wherein a single-stage, axial-flow turbine 22 is affixed to output shaft 26. In the reverse mode of operation, the reverse turbine inlet scroll 20 directs the gas flow through a plurality of turbine blades 23 to an exhaust diffuser 25, from which it is discharged into exhaust elbow 24.

In operation, when the gas turbine engine according to the present invention is in the full forward mode, diverter blocks 32 are retracted and flaps 50 are closed so that all of the working fluid discharging from gas generator 12 is directed through annular flow channel 34 to the inlet 35 of power turbine 14. Exhaust valve 28 is at its rearmost position so that the exhaust end of reverse turbine 22 is completely blocked, while valve 28 acts as a conical diffuser for the exhaust flow discharging from power turbine 14. Reverse turbine 22 is further isolated by the closure of shut-off valves 30.

When the gas turbine engine is operated in the full reverse mode, flaps 50 are opened and diverter blocks 32 are fully inserted into annular flow channel 34, whereby all of the working fluid is directed through collector scroll 16 and into bypass ducts 18. Shut-off valves 30 are fully opened so that the working fluid flows into reverse turbine inlet scroll 20. Exhaust valve 28 is moved to the full forward position, blocking the exhaust end of power turbine 14 and permitting the working fluid to flow through reverse turbine 22 and into exhaust elbow 24. Intermediate and full-stop power settings are achieved by proportioning the working fluid flow between power turbine 14 and reverse turbine 22. The flow is proportioned by a combination of partial insertion of diverter blocks 32 into annular channel 34, partial closure of shut-off valve 30, and the spacing of exhaust valve 28 at a position intermediate of the exhaust ends of the turbines. Output shaft 26 is stopped when the torque produced by power turbine 14 equals the torque produced by reverse turbine 22.

Thus, it is apparent that there is provided by the present invention a reversing system for gas turbine engines having means for selectively isolating the unused turbine and minimizing windage losses therefrom without sacrificing the forward mode performance of the engine. There is also provided a means for proportioning the working fluid flow between the power and reverse turbines throughout the power range of the gas generator.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

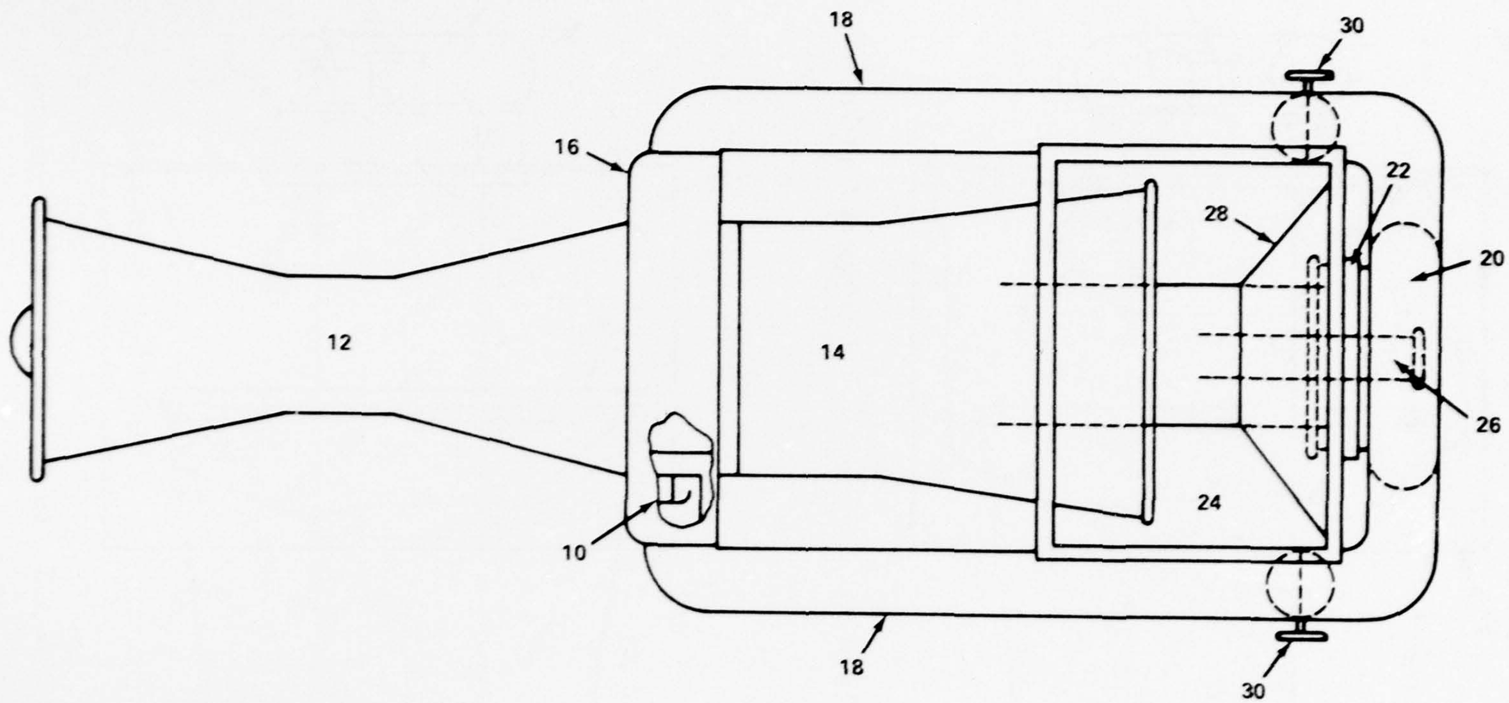


Figure A.1 - Isolated Reverse-Turbine System

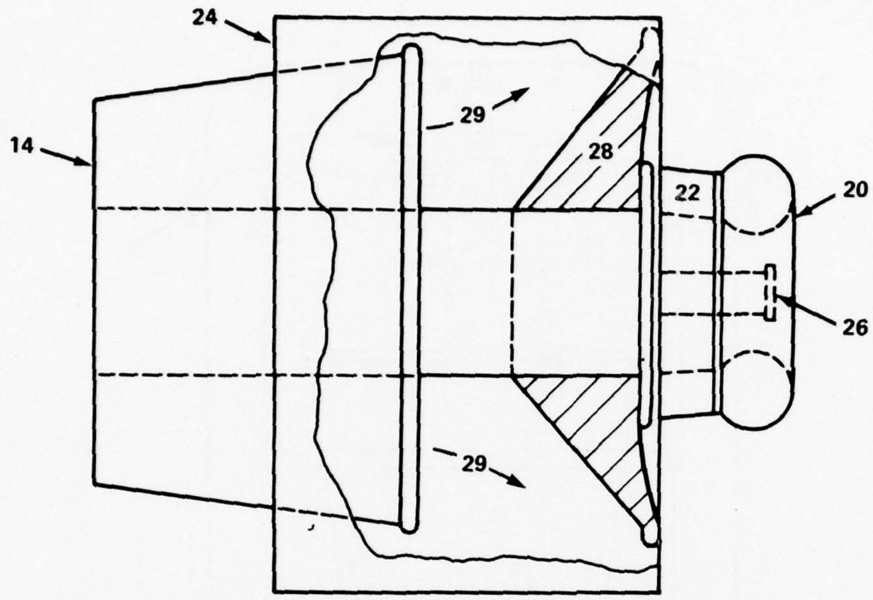


Figure A.2 - Exhaust Elbow (Forward Position)

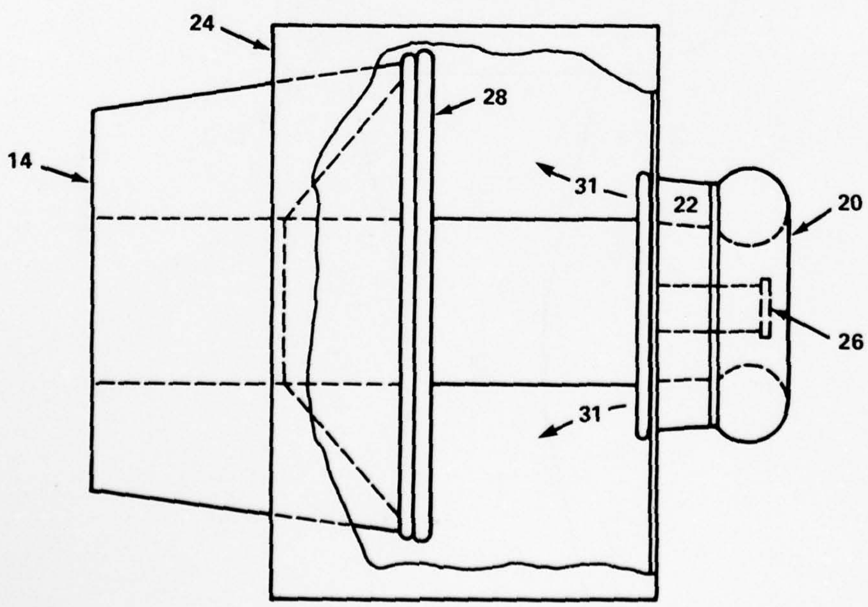


Figure A.3 - Exhaust Elbow (Reverse Position)

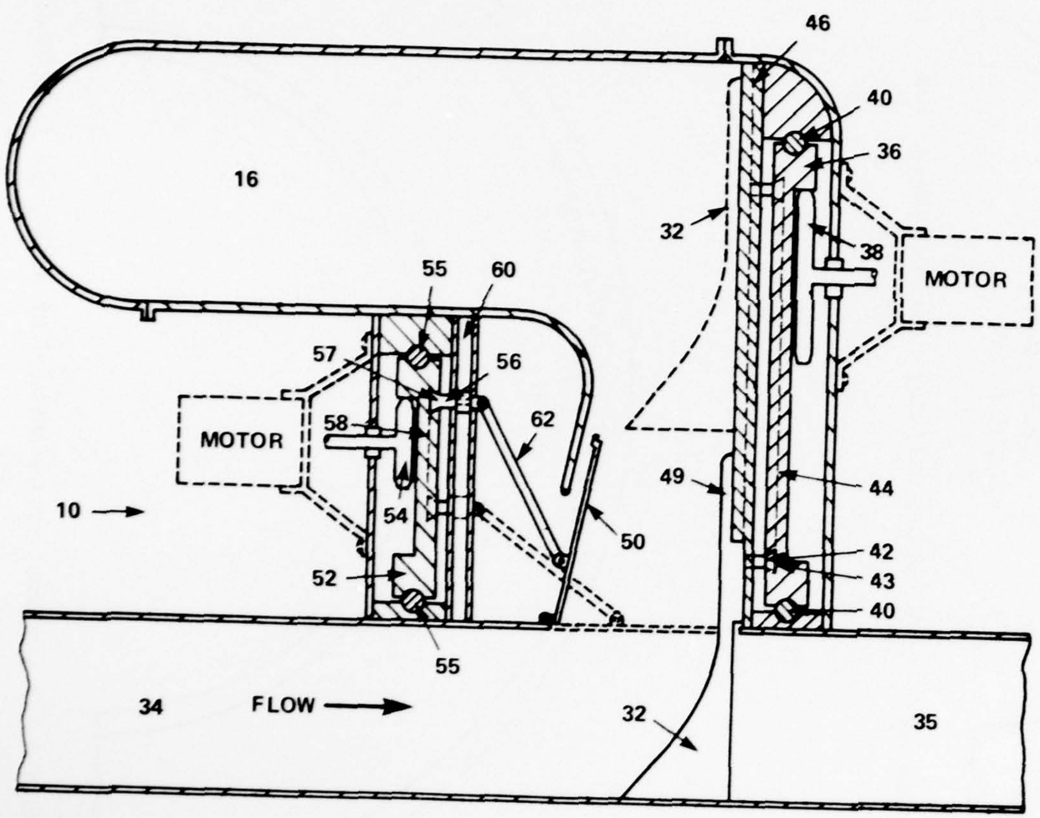


Figure A.4 - Inlet Valve Mechanism

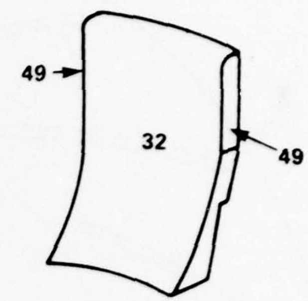


Figure A.4a - Diverter Block (32)
Viewed from Upstream

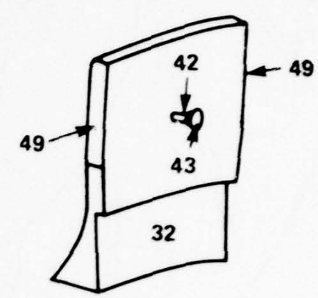


Figure A.4b - Diverter Block (32)
Viewed from Downstream

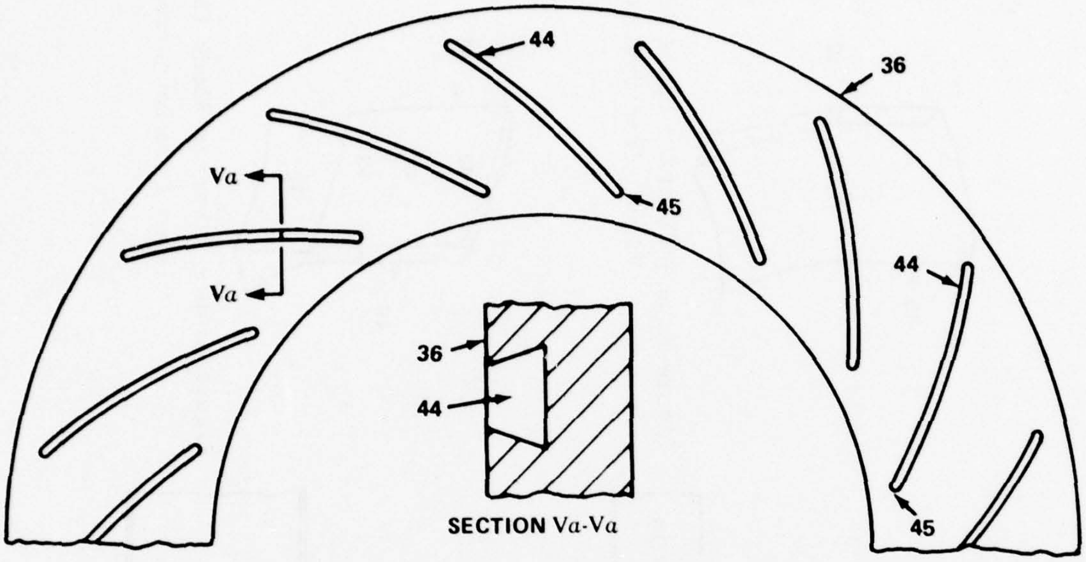


Figure A.5 - Combination Cam/Ring Gear as Viewed from Upstream

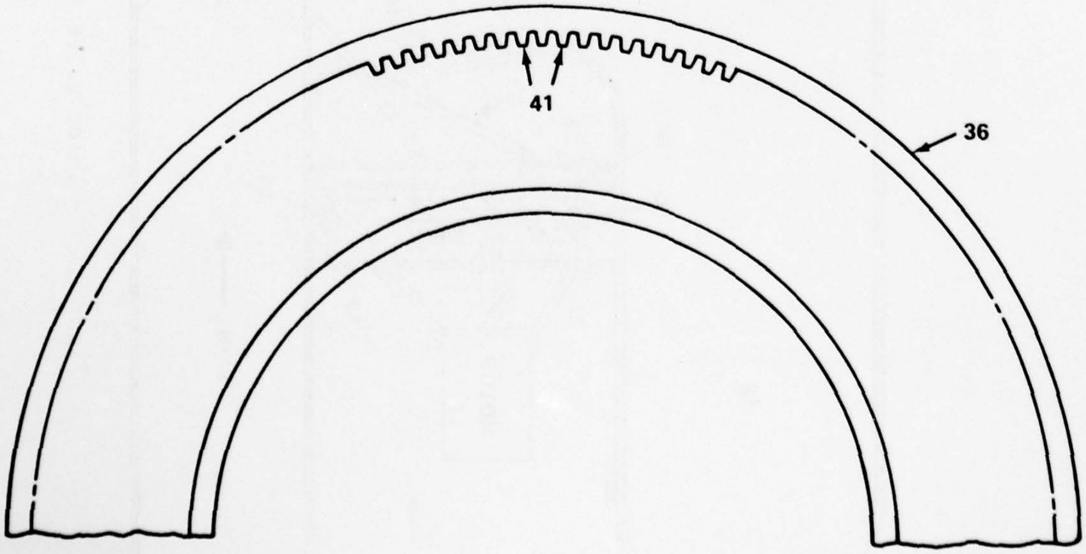
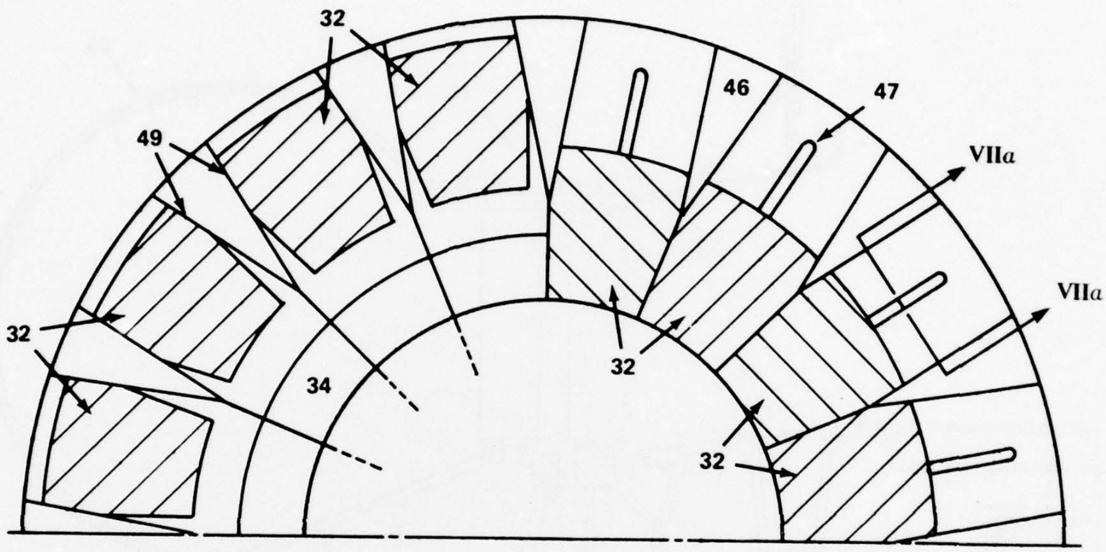
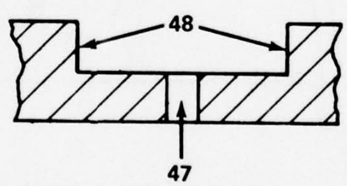


Figure A.6 - Combination Cam/Ring Gear as Viewed from Downstream





SECTION VIIa-VIIa

Figure A.7 - Guide Ring as Viewed from Upstream

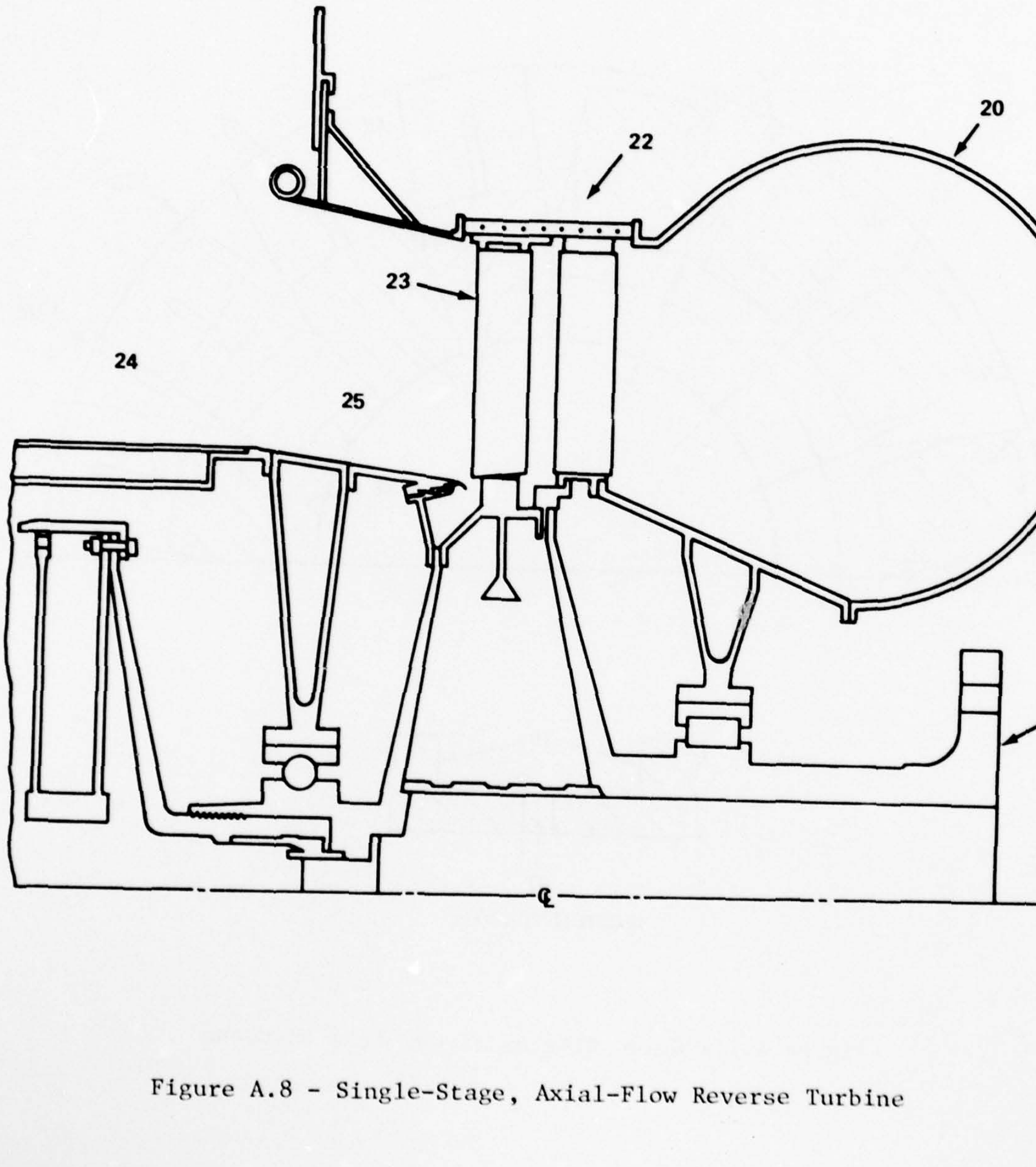


Figure A.8 - Single-Stage, Axial-Flow Reverse Turbine

APPENDIX B

DESCRIPTION OF SHIP-REVERSING COMPUTER PROGRAM

The purpose of this appendix is to give details on the ship-reversing computer program, including a general description of the main program and its subroutines, flow charts, program listing, nomenclature, and sample input and output data. The main program serves several functions, some of which include reading the input data, controlling the sequence of events during execution, and printing the results. Initial guesses for the independent variables (engine output speed and ship speed) are part of the input data. As illustrated in Figure B.1, the values for the independent variables are passed along to subroutine SHIP, which returns values for the dependent variables or base errors (net power and net thrust). In order to satisfy the ship's power and thrust equations, a modified Newton-Raphson convergence technique is used in subroutine CVERGE to determine the correct solutions for the independent variables. The initial guesses and base errors are transferred to subroutine CVERGE from the main program. By calculating the change in error due to a small change in the independent variable, a matrix of coefficients is generated. Subroutine MATINS is used to invert the matrix and, as a result, better guesses for the independent variables are obtained. The process is repeated until the base errors are reduced to negligible values. The BLOCK DATA subroutine contains values for several constants, such as propeller diameter, ship displacement, reduction gear ratio, thrust deduction factors, wake factor, inertias, etc.

As shown in Figure B.2, subroutine SHIP is supported by several other routines:

1. FPSCREW (calculates fixed-pitch propeller performance)

2. TRQLOS (curve-fitted equation for transmission losses as a function of shaft speed)

3. TRQPLOT (used during transient simulations to model the variation in engine torque as a function of time)

4. FPPMAP (contains the thrust and torque coefficients for the fixed-pitch propeller as a function of modified advance ratio)

5. DRAG (series of curve-fitted equations which model the ship's resistance as a function of ship speed)

6. SRCH (used to search a one-dimensional array)

7. TABX (used to interpolate values from data tables).

A FORTRAN listing of the ship-reversing computer program is given in Appendix C. Subroutines CVERGE, MATINS, TABX, and SRCH are utility routines, and therefore are not included in Appendix C. A guide to the nomenclature used in the computer program is provided on pages 94 and 95.

To execute the reverse-turbine computer program, a minimum of two input data cards are required. The format of these data cards is as follows.

Card 1

Column	Input Variable	Description
2	MODE	Identifies the type of run to be made: MODE = 1 implies steady-state run MODE = 2 implies transient run
4	SI	Identifies the system of measurement: SI = 0 U.S. customary units SI = 1 International units (inactive)
6	IPRT1	On-off switch for iteration print statements: IPRT1 = 1, on (useful in case of failure) IPRT1 = 0, off
8	IPRT2	On-off switch for steady-state data: IPRT2 = 1, on (if MODE = 1) IPRT2 = 0, off (if MODE = 2)
10	IPRT3	On-off switch for transient data: IPRT3 = 1, on (if MODE = 2) IPRT3 = 0, off (if MODE = 1)

Card 2

Column	Input Variable	Description
1-10	WF	Fuel flow rate per engine (lb_m/hr)
11-20	XNENG	Engine output speed (rpm): Positive value for ahead operation Negative value for astern operation
21-30	VSHIP	Ship speed (knots): Positive value for ahead operation Negative value for astern operation

To obtain a series of steady-state data points during a single run, the format for each ahead and/or astern operating point is the same as Card 2 shown above. In a transient run, Card 2 is used to calculate the initial conditions at time equal to zero.

A sample output for a steady-state calculation is shown on page 98 Appendix D. In this case IPRT1 = 1, which activates the iteration print statements. The initial guesses for engine output speed and ship speed are 4000 rpm and 30 knots, respectively. After four iterations, the correct values for these independent variables are found to be 3394 rpm and 29.66 knots. Note that the base errors (net thrust and unbalanced power) are very small. Since IPRT2 = 1, the values of several parameters are listed after solution convergence is obtained.

A sample output for a transient crashback simulation is shown on pages 99 through 118, Appendix D. The forcing function in the transient simulation is a variation in engine torque as a function of time, which is defined in subroutine TRQPLOT. In this case, engine torque decreases from full-ahead torque (+30,690 ft-lb_f) to full-astern torque (-25,000 ft-lb_f) in 12.5 s. Several interesting features which are apparent in the sample output include:

1. Propeller thrust (THPROP) changes sign at TIME = 5.8 s
2. Propeller torque (TQPROP) changes sign at TIME = 7.7 s
3. Propeller rpm (XNENG) changes sign at TIME = 15.47 s
4. Ship speed (VSHIP) changes sign at TIME = 55.15 s.
5. Maximum head reach is 1395 ft (3.1 ship lengths).

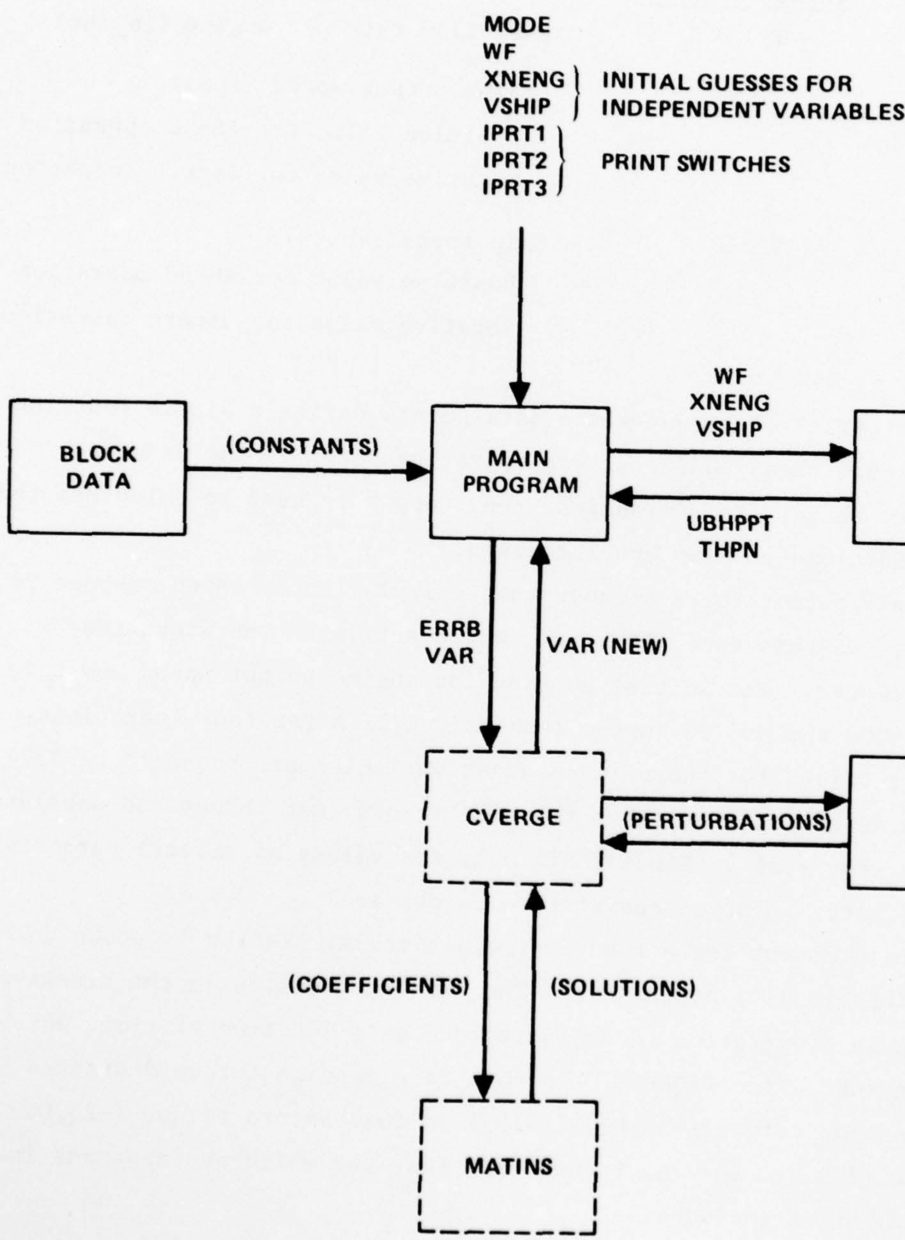


Figure B.1 - General Flow Diagram of Ship-Reversing Computer Program

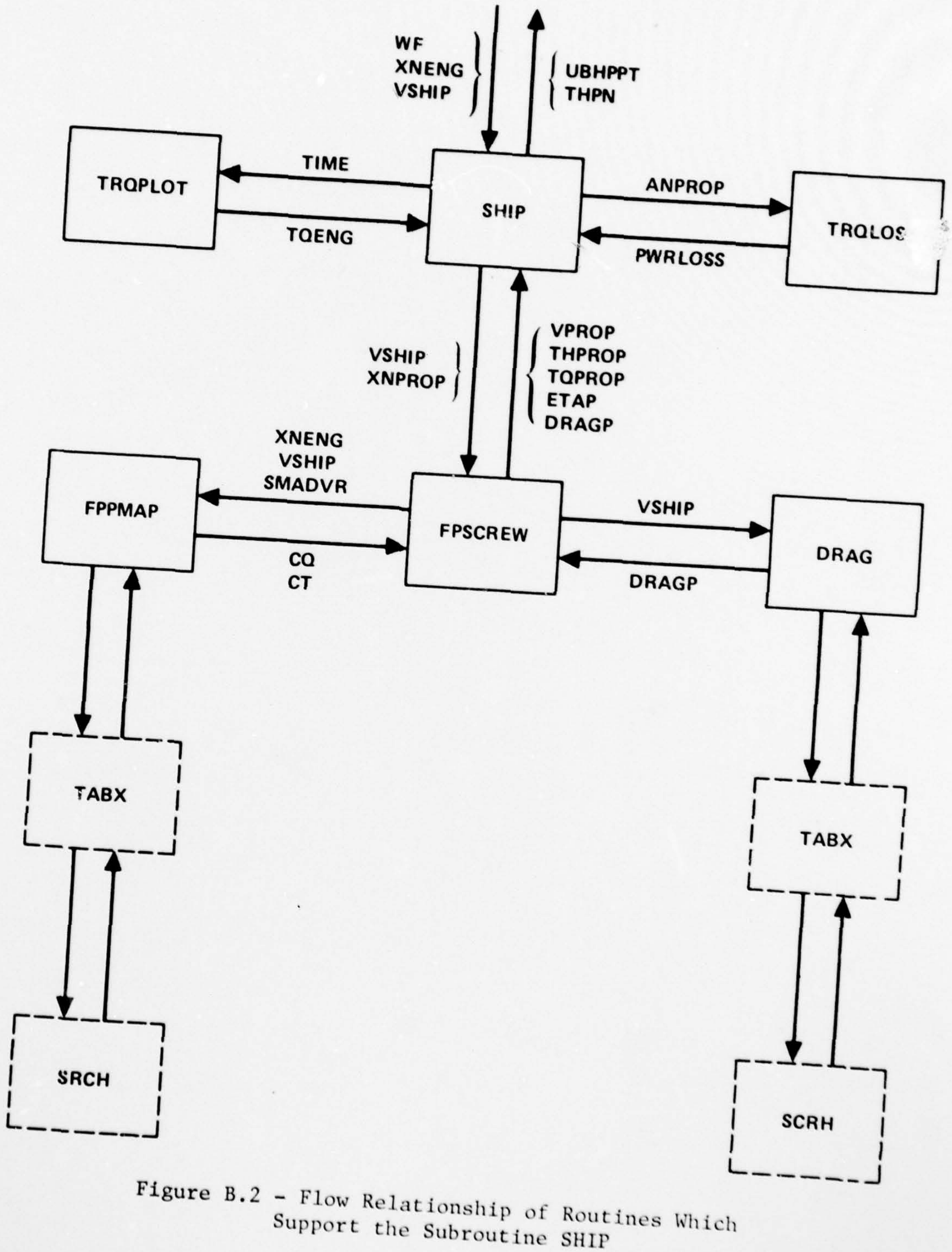


Figure B.2 - Flow Relationship of Routines Which Support the Subroutine SHIP

APPENDIX C

FORTRAN LISTING OF SHIP-REVERSING COMPUTER PROGRAM

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```
      PROGRAM RVRSTRB(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
C
C     DYNAMIC ANALYSIS COMPUTER PROGRAM FOR AN ISOLATED REVERSE TURBINE
C
C                                 BY
C                             T.L.BOWEN
C
C                          DTNSRDC CODE 2721
C                           ANNAPOLIS, MD
C                              21402
C
C                            1 NOV 1977
C                       *********************
C
      DIMENSION VAR(2),ERRB(2)
C
      COMMON/SHIP/DISPL,GR,XILD1,XILD2,XNEO,SFDRAG
      COMMON/CONS/GC,H2O,PI,XKP
      COMMON/PRINT3/TQENG,XNPROP,SHAOVR,THPROP,TQPROP,PWRENG
C
      DATA TOLER/.001/
      DATA NMAX/2/
C
      NLINE= 0
      NPT= 0
      READ(5,100)MODE,SI,IPRT1,IPRT2,IPRT3
    5 READ(5,105)WF,XNENG,VSHIP
      IF(WF.EQ.0.0) STOP
C     INITIAL GUESSES FOR INDEPENDENT VARIABLES
      VAR(1)=XNENG
      VAR(2)=VSHIP
C
      TIME=0.0
      XNOLD=0.0
      VSOLD=0.0
      REACH=0.0
      TSTEP=0.1
      XI=XILD2
      IF(XNEO.EQ.1.) XI=XILD1
      NPT= NPT+1
      IF(IPRT1.EQ.0) GO TO 8
      IF(XNENG.LT.0.) GO TO 7
      WRITE(6,106) NPT
      GO TO 8
    7 CONTINUE
      WRITE(6,107) NPT
    8 IF(TIME.GT.100.) STOP
      ISSE=0
      NPASS=1
   10 CALL SHIP(SI,WF,TIME,TSTEP,VAR,XNOLD,VSOLD,0,UBHPPT,PWRPRP,
     $         THPN,DRAGP,DNENG,DVSHIP)
      XNORM1=20000.
      ERRB(1)=(UBHPPT-XI/(GC*XKP*XNEO)*VAR(1)*DNENG*(2.*PI/60.)**2.)/
     $        XNORM1
      XNORM2=150000.
      ERRB(2)=(THPN-DISPL*DVSHIP*6076.1/3600.)/XNORM2
      SSE=0.0
```

AD-A077 898 DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/G 21/5
FEASIBILITY STUDY OF AN ISOLATED REVERSE-TURBINE SYSTEM FOR GAS--ETC(U)
DEC 79 T L BOWEN
UNCLASSIFIED DTNSRDC-79/033 NL

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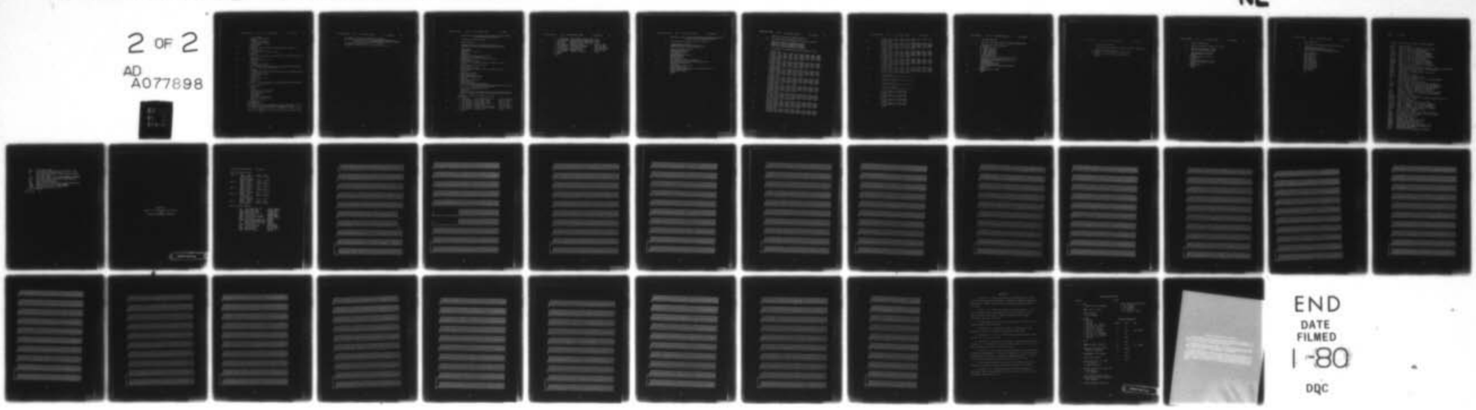
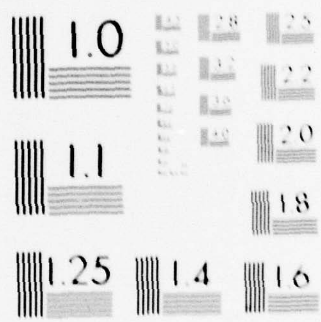


END
DATE
FILMED
1-80
DDC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
                DO 15 I=1,NMAX
                SSE=SSE+ABS(ERRB(I))**2.
             15 CONTINUE
                IF(TIME.GT.0.) IPRT1=0
                IF(IPRT1.EQ.0) GO TO 20
                IF(NPASS.NE.1) GO TO 18
                WRITE(6,108)
             18 CONTINUE
                WRITE(6,110)NPASS,(VAR(I),I=1,NMAX),(ERRB(I),I=1,NMAX),SSE
             20 CONTINUE
                DO 25 I=1,NMAX
                IF(ABS(ERRB(I)).GT.TOLER) GO TO 30
             25 CONTINUE
                GO TO 35
             30 CALL CVERGE(SI,VAR,XNOLD,VSOLD,ERRB,ISSE,SSE,WF,IPRT1,TSTEP,TIME)
                ISSE=1
                NPASS=NPASS+1
                IF(NPASS.GT.30) GO TO 50
                GO TO 10
             35 CONTINUE
                IF(TIME.GT.0.) IPRT2=0
                IF(IPRT2.EQ.0) GO TO 40
                CALL SHIP(SI,WF,TIME,TSTEP,VAR,XNOLD,VSOLD,IPRT2,UBHPPT,PWRPRP,
               $          THPN,DRAGP,DNENG,DVSHIP)
             40 CONTINUE
                IF(MODE.EQ.1) GO TO 5
                IF(TIME.GT.0.)  REACH=REACH+((VAR(2)+VSOLD)*.5)*TSTEP*6076.1/3600.
                IF(IPRT3.EQ.0) GO TO 45
                IF(TIME.GT.0) GO TO 42
                WRITE(6,115)
             42 CONTINUE
                IF(NLINE.NE.55) GO TO 43
                WRITE(6,115)
                NLINE= 0
             43 WRITE(6,120)TIME,VAR(1),VAR(2),TQENG,PWRENG,XNPROP,SMADVR,THPROP,
               $            TQPROP,REACH
                NLINE= NLINE+1
             45 CONTINUE
                SGP=0.2
                SGN=-.2
                IF(SMADVR.LT.SGP)  TSTEP=0.01
                IF(SMADVR.LT.SGN)  TSTEP=0.1
                TIME=TIME+TSTEP
                XNOLD=VAR(1)
                VSOLD=VAR(2)
                VAR(1)=VAR(1)+DNENG*TSTEP
                VAR(2)=VAR(2)+DVSHIP*TSTEP
                GO TO 8
             50 WRITE(6,125) NPASS
            100 FORMAT(5I2)
            105 FORMAT(3F10.2)
            110 FORMAT(1X ,7HNPASS= ,I2,5X,8HVAR(1)= ,F6.0,9X,8HVAR(2)= ,F6.2/15X,
               * 9HERRB(1)= ,E9.3,5X,9HERRB(2)= ,E9.3/15X,5HSSE= ,E9.3)
            106 FORMAT(1H1,30HSTEADY-STATE AHEAD PERFORMANCE,5X,13HPOINT NUMBER ,
               *          I2//)
            107 FORMAT(1H1,31HSTEADY-STATE ASTERN PERFORMANCE,5X,13HPOINT NUMBER ,
               *          I2//)
```

```
      108 FORMAT(1X ,30HSOLUTION CONVERGENCE ATTEMPTED/)
      115 FORMAT(1H1,18HTRANSIENT RESULTS://1X,5HTIME=,8X,6HXNENG=,7X,
     $        6HVSHIP=,7X,6HTQENG=,7X,7HPWRENG=,6X,7HXNPROP=,6X,7HSMADVR=
     $        ,6X,7HTHPROP=,6X,7HTQPROP=,6X,6HREACH=)
      120 FORMAT(1X,10(F10.4,3X))
      125 FORMAT(/1X,35HMAX NO ITERATIONS EXCEEDED NPASS = ,I2)
          END
```

```
      SUBROUTINE SHIP(SI,WF,TIME,TSTEP,VAR,XNOLD,VSOLD,IPRT2,UBHPPT,
     $                PWRPRP,THPN,DRAGP,DNENG,DVSHIP)
C
C     SHIP MODEL (TLB 2721 10-18-77)
C
      DIMENSION VAR(2)
C
      COMMON/SHIP/DISPL,GR,XTLD1,XTLD2,XNEO,SFDRAG
      COMMON/PRINT3/TQENG,XNPROP,SMADVR,THPROP,TQPROP,PWRENG
C
      XNENG=VAR(1)
      VSHIP=VAR(2)
      IF(TIME.GT.0.) GO TO 30
      DNENG=0.0
      DVSHIP=0.0
      IF(TIME.EQ.0.AND.XNENG.GT.0) GO TO 10
      IF(TIME.EQ.0.AND.XNENG.LT.0) GO TO 20
C     STEADY-STATE AHEAD TURBINE (LM2500 FPT) MODEL
   10 SWF=WF/1000.
      SXNENG=ABS(XNENG)/1000.
      TQENG=(-0.925*SWF*SXNENG+8.25*SWF-2.5*SXNENG-2.1)*1000.
      GO TO 40
C     STEADY-STATE ASTERN TURBINE MODEL
   20 SWF=WF/1000.
      SXNENG=ABS(XNENG)/1000.
      TQENG=(-.925*SWF*SXNENG+8.25*SWF-2.5*SXNENG-2.1)*1000.
      TQENG=-TQENG
      GO TO 40
C     TRANSIENT TORQUE MODEL
   30 TQENG=TRQPLOT(TIME)
      DNENG=(XNENG-XNOLD)/TSTEP
      DVSHIP=(VSHIP-VSOLD)/TSTEP
   40 CONTINUE
      PWRENG=TQENG*XNENG/5252.
      XNPROP=XNENG/GR
      ANPROP=ABS(XNPROP)
      PWRLOSS=TRQLOS(ANPROP)*ANPROP/5252.
      CALL FPSCREW(SI,VSHIP,XNPROP,VPROP,ADVR,FMADVR,SMADVR,CQ,CT,THPROP
     $             ,DRAGP,THPN,TQPROP,PWRPRP,ETAP)
      UBHPPT=PWRENG-(PWRPRP+PWRLOSS)/XNEO
      IF(IPRT2.EQ.0) GO TO 110
      WRITE(6,95)
      WRITE(6,100)WF,XNENG,TQENG,PWRENG,PWRLOSS,VSHIP,XNPROP,VPROP,ADVR
      WRITE(6,105)FMADVR,SMADVR,CQ,CT,THPROP,DRAGP,THPN,TQPROP,PWRPRP,
     $             ETAP
   95 FORMAT(/1X,29HSOLUTION CONVERGENCE OBTAINED )
  100 FORMAT(
     $  /15X,38HWF        FUEL FLOWRATE PER ENGINE       ,E10.4,9H (LBS/HR)
     $  /15X,38HXNENG     ENGINE OUTPUT SPEED            ,E10.4,9H (RPM)
     $  /15X,38HTQENG     ENGINE OUTPUT TORQUE           ,E10.4,9H (FT-LBF)
     $  /15X,38HPWRENG    ENGINE OUTPUT POWER            ,F10.4,9H (HP)
     $  /15X,38HPWRLOSS   MECH.TRANSMISSION LOSSES       ,E10.4,9H (HP)
     $  /15X,38HVSHIP     SHIP VELOCITY                  ,E10.4,9H (KNOTS)
     $  /15X,38HXNPROP    PROPELLER ROTATIONAL SPEED     ,E10.4,9H (RPM)
     $  /15X,38HVPROP     PROPELLER SPEED OF ADVANCE     ,E10.4,9H (FT/MIN)
     $  /15X,38HADVR      ADVANCE RATIO                  ,E10.4)
  105 FORMAT(
```

```
      $   15X,38HFMADVR  FIRST MODIFIED ADVANCE RATIO  ,E10.4
      $  /15X,38HSMADVR  SECOND MODIFIED ADVANCE RATIO ,E10.4
      $  /15X,38HCQ      PROPELLER TORQUE COEFFICIENT  ,E10.4
      $  /15X,38HCT      PROPELLER THRUST COEFFICIENT  ,E10.4
      $  /15X,38HTHPROP  PROPELLER THRUST              ,E10.4,9H (LBF)
      $  /15X,38HDRAGP   TOTAL SHIP RESISTANCE         ,E10.4,9H (LBF)
      $  /15X,38HTHPN    NET PROPELLER THRUST          ,E10.4,9H (LBF)
      $  /15X,38HTQPROP  PROPELLER TORQUE              ,E10.4,9H (FT-LBF)
      $  /15X,38HPWRPRP  PROPELLER POWER               ,E10.4,9H (HP)
      $  /15X,38HETAP    PROPELLER EFFICIENCY          ,E10.4)
  110 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FPSCREW(SI,VSHIP,XNPROP,VPROP,ADVR,FMADVR,SMADVR,CQ,CT,
     $                   THPROP,DRAGP,THPN,TQPROP,PWRPRP,ETAP)
C
C     FIXED-PITCH PROPELLER MODEL  (TLB 2721 10-13-77)
C
      COMMON/CONS/GC,H2O,PI,XKP
      COMMON/PROP/DIAM,TDFAHD,TDFAST,WAKFAC
      COMMON/SHIP/DISPL,GR,XILD1,XILD2,XNEO,SFDRAG
C
      VPROP=VSHIP*WAKFAC*6076.1/60.
      XJ=VPROP/(XNPROP*DIAM)
      VU=0.7*PI*XNPROP*DIAM
      ADVR=VPROP/VU
      VREL=SQRT(VPROP**2.+VU**2.)
      FMADVR=VPROP/VREL
      SMADVR=VU/VREL
      AREA=(PI*DIAM**2.)/4.
      CALL FPPMAP(VSHIP,XNPROP,SMADVR,CQ,CT)
      THPROP=(CT*AREA*(H2O/GC/2.)*(VREL/60.)**2.)/4.84
      DRAGP=SFDRAG*DRAG(VSHIP)
      TDF=TDFAHD
      IF(THPROP.LT.0.0) TDF=TDFAST
      THPN=THPROP*TDF-DRAGP
      TQPROP=(CQ*AREA*DIAM*(H2O/GC/2.)*(VREL/60.)**2.)/4.84
      PWRPRP=TQPROP*XNPROP/5252.
      ETAP=CT*XJ/(2.*PI*CQ)
      RETURN
      END
```

```
      SUBROUTINE FPPMAP(VSHIP,XNPROP,SMADVR,CQ,CT)
C
C     FIXED-PITCH PROPELLER PERFORMANCE MAP (TLB 2721 10-14-77)
C
      DIMENSION SG1TAB(42),CQ1TAB(42),CT1TAB(42)
      DIMENSION SG2TAB(41),CQ2TAB(41),CT2TAB(41)
      DIMENSION SG3TAB(42),CQ3TAB(42),CT3TAB(42)
      DIMENSION SG4TAB(41),CQ4TAB(41),CT4TAB(41)
C
C     FOUR QUADRANT OPEN-WATER DATA FOR NSRDC PROPELLER NO 4426
C
      DATA SG1TAB/
     $ .0000, .1093, .2149, .3134, .4027, .4819, .5508, .6101, .6606,
     $ .7035, .7399, .7708, .7971, .8195, .8387, .8552, .8694, .8778,
     $ .8818, .8926, .9020, .9103, .9181, .9255, .9328, .9398, .9465,
     $ .9529, .9590, .9648, .9701, .9751, .9797, .9839, .9875, .9908,
     $ .9936, .9959, .9977, .9990, .9997, 1.000/
      DATA CQ1TAB/
     $-.1381,-.7253,-.7257,-.6315,-.5689,-.4961,-.4110,-.3511,-.2925,
     $-.2334,-.1847,-.1453,-.1068,-.0744,-.0480,-.0242,-.0040, .0082,
     $ .0128, .0254, .0375, .0477, .0575, .0676, .0776, .0877, .0976,
     $ .1075, .1176, .1275, .1373, .1469, .1564, .1659, .1751, .1842,
     $ .1931, .2015, .2099, .2181, .2257, .2320/
      DATA CT1TAB/
     $-.8093,-1.868,-1.943,-1.825,-1.710,-1.445,-1.151,-.9668,-.9057,
     $-.8318,-.7250,-.5992,-.4870,-.3796,-.2741,-.1751,-.0808, .0000,
     $ .0158, .0913, .1616, .2195, .2812, .3424, .4055, .4700, .5361,
     $ .5812, .6675, .7348, .8028, .8692, .9361, 1.001, 1.065, 1.127,
     $ 1.187, 1.245, 1.300, 1.357, 1.400, 1.446/
      DATA SG2TAB/
     $-1.000,-.9997,-.9990,-.9977,-.9959,-.9936,-.9908,-.9875,-.9839,
     $-.9797,-.9751,-.9701,-.9648,-.9590,-.9529,-.9465,-.9398,-.9328,
     $-.9255,-.9181,-.9103,-.9020,-.8926,-.8818,-.8694,-.8522,-.8387,
     $-.8195,-.7971,-.7708,-.7399,-.7035,-.6606,-.6101,-.5508,-.4819,
     $-.4027,-.3134,-.2149,-.1093, .0000/
      DATA CQ2TAB/
     $-.2294,-.2344,-.2407,-.2408,-.2372,-.2275,-.2112,-.1927,-.1760,
     $-.1630,-.1569,-.1572,-.1643,-.1733,-.1822,-.1919,-.2008,-.2116,
     $-.2218,-.2325,-.2427,-.2538,-.2658,-.2780,-.2920,-.3067,-.3251,
     $-.3461,-.3720,-.4035,-.4398,-.4792,-.5242,-.5745,-.6231,-.6675,
     $-.6693,-.7602,-.6391,-.6084,-.1381/
      DATA CT2TAB/
     $-1.232,-1.265,-1.281,-1.278,-1.250,-1.169,-1.055,-.9511,-.8751,
     $-.8334,-.8232,-.8531,-.9031,-.9672,-1.040,-1.116,-1.183,-1.254,
     $-1.317,-1.389,-1.452,-1.523,-1.601,-1.691,-1.784,-1.894,-2.026,
     $-2.179,-2.356,-2.560,-2.799,-3.059,-3.347,-3.674,-3.882,-4.176,
     $-4.146,-4.002,-3.973,-3.803,-.8093/
      DATA SG3TAB/
     $-1.000,-.9997,-.9990,-.9977,-.9959,-.9936,-.9908,-.9875,-.9839,
     $-.9797,-.9751,-.9701,-.9648,-.9590,-.9529,-.9465,-.9398,-.9328,
     $-.9255,-.9181,-.9103,-.9067,-.9020,-.8926,-.8818,-.8694,-.8552,
     $-.8387,-.8195,-.7971,-.7708,-.7399,-.7035,-.6606,-.6101,-.5508,
     $-.4819,-.4027,-.3134,-.2149,-.1093, .0000/
      DATA CQ3TAB/
     $-.2294,-.2222,-.2145,-.2063,-.1975,-.1880,-.1782,-.1676,-.1570,
     $-.1459,-.1346,-.1229,-.1112,-.0993,-.0872,-.0753,-.0634,-.0516,
     $-.0397,-.0283,-.0169,-.0113,-.0052, .0065, .0208, .0395, .0615,
```

```
     $ .0967, .1151, .1456, .1832, .2260, .2789, .3495, .4408, .5329,
     $ .6401, .7634, .8683, .9184, .9514, .1228/
      DATA CT3TAB/
     $-1.232,-1.204,-1.164,-1.120,-1.071,-1.018,-.9624,-.9014,-.8406,
     $-.7748,-.7094,-.6399,-.5713,-.5012,-.4762,-.3627,-.2946,-.2260,
     $-.1592,-.0964,-.0317, .0000, .0394, .1055, .1703, .2656, .3874,
     $ .5294, .7029, .9060, 1.129, 1.419, 1.713, 2.066, 2.481, 3.030,
     $ 3.657, 4.352, 5.073, 5.272, 5.249, .7735/
      DATA SG4TAB/
     $ .0000, .1093, .2149, .3134, .4027, .4819, .5508, .6101, .6606,
     $ .7035, .7399, .7708, .7971, .8195, .8387, .8552, .8694, .8818,
     $ .8926, .9020, .9103, .9181, .9255, .9328, .9398, .9465, .9529,
     $ .9598, .9649, .9701, .9751, .9797, .9839, .9875, .9908, .9936,
     $ .9959, .9977, .9990, .9997, 1.000/
      DATA CQ4TAB/
     $ .1225, .6208, .6426, .6871, .7508, .7948, .7989, .6819, .5394,
     $ .4928, .4398, .4046, .3728, .3477, .3269, .3084, .2956, .2774,
     $ .2639, .2523, .2416, .2312, .2207, .2100, .1999, .1896, .1799,
     $ .1703, .1643, .1620, .1663, .1755, .1901, .2056, .2217, .2328,
     $ .2402, .2439, .2437, .2390, .2320/
      DATA CT4TAB/
     $ .7735, 3.951, 3.973, 4.182, 4.548, 4.686, 4.440, 4.033, 3.608,
     $ 3.257, 2.954, 2.707, 2.477, 2.317, 2.166, 2.028, 1.904, 1.794,
     $ 1.692, 1.597, 1.517, 1.434, 1.357, 1.283, 1.214, 1.148, 1.082,
     $ 1.016, .9766, .9634, .9758, 1.034, 1.124, 1.214, 1.305, 1.385,
     $ 1.442, 1.475, 1.482, 1.474, 1.446/
C
C     AHEAD QUADRANT
      IF(VSHIP.GE.0.AND.XNPROP.GT.0) GO TO 10
C
C     CRASHBACK QUADRANT
      IF(VSHIP.GT.0.AND.XNPROP.LE.0) GO TO 20
C
C     BACKING QUADRANT
      IF(VSHIP.LE.0.AND.XNPROP.LT.0) GO TO 30
C
C     CRASHAHEAD QUADRANT
      IF(VSHIP.LT.0.AND.XNPROP.GE.0) GO TO 40
C
   10 CQ=TABX(SMADVR,42,SG1TAB,CQ1TAB)
      CT=TABX(SMADVR,42,SG1TAB,CT1TAB)
      RETURN
   20 CQ=TABX(SMADVR,41,SG2TAB,CQ2TAB)
      CT=TABX(SMADVR,41,SG2TAB,CT2TAB)
      RETURN
   30 CQ=TABX(SMADVR,42,SG3TAB,CQ3TAB)
      CT=TABX(SMADVR,42,SG3TAB,CT3TAB)
      RETURN
   40 CQ=TABX(SMADVR,41,SG4TAB,CQ4TAB)
      CT=TABX(SMADVR,41,SG4TAB,CT4TAB)
      RETURN
      END
```

```
      FUNCTION DRAG(VSHIP)
C
C     SHIP DRAG CURVE MODEL (BASED ON LM2500/FFG DYNAMIC DECK)
C
      DIMENSION VX(9),XKX(9),COEF(3,7)
      DATA COEF/
     $  -.325,-9.01,-70.57,
     $  -.0625,-.50,-1.5,
     $  -.0218,.0125,0.0,
     $  .0187,-.0125,0.0,
     $  .0234,-.0438,-.05,
     $  .0422,-.681,5.34,
     $  .0656,-1.06,.994  /
      DATA VX/-50.,-21.,-16.,-8.,0.,8.,16.,24.,50./
      DATA XKX/0.,1.,2.,3.,4.,5.,6.,7.,8./
      IF(VSHIP.LE.1.0.AND.VSHIP.GE.0.0) GO TO 100
      VSQ=VSHIP*VSHIP
      XK=TABX(VSHIP,9,VX,XKX)
      K=MIN1(AMAX1(XK,1.),7.)
      R=COEF(1,K)*VSQ+COEF(2,K)*VSHIP+COEF(3,K)
      DRAG=R*1.0E4
      RETURN
  100 DRAG=0.0062*VSQ  *1.0E4
      RETURN
      END
```

```
                FUNCTION TRQLOS(ANPROP)
C
C               SHIP DRIVE TRAIN LOSSES MODEL (BASED ON LM2500/FFG DYNAMIC DECK)
C
                IF(ANPROP-100.) 100,200,200
          100   TRQLOS=-.405*ANPROP*ANPROP+134.2*ANPROP+7740.
                RETURN
          200   TRQLOS=1.05*ANPROP*ANPROP-106.*ANPROP+17200.
                RETURN
                END
```

```
      FUNCTION TRQPLOT(TIME)
C
C     TRANSIENT TORQUE MODEL (TLB 2721 12-12-77)
C
      DATA T0,T1,T2,T3/0.,5.,7.5,12.5/
      DATA TQAHD,TQAST/30690.,-25000./
C
      IF((TIME-T1).GT.0.) GO TO 10
      TRQPLOT=TQAHD*(1.-(TIME/T1))
      RETURN
   10 IF((TIME-T2).GT.0.) GO TO 15
      TRQPLOT=0.0
      RETURN
   15 IF((TIME-T3).GT.0.) GO TO 20
      TRQPLOT=TQAST*(TIME-T2)/(T3-T2)
      RETURN
   20 TRQPLOT=TQAST
      RETURN
      END
```

```
      BLOCK DATA DESDAT
C
C     DESIGN DATA FOR PROGRAM RVRSTRB (TLB 2721 10-18-77)
C
      COMMON/CONS/GC,H2O,PI,XKP
      COMMON/PROP/DIAM,TDFAHD,TDFAST,WAKFAC
      COMMON/SHIP/DISPL,GR,XILD1,XILD2,XNEO,SFDRAG
C
      DATA DIAM/16.5/
      DATA DISPL/270725./
      DATA GC/32.17/
      DATA GR/17.075/
      DATA H2O/62.4/
      DATA PI/3.1416/
      DATA SFDRAG/1.11/
      DATA TDFAHD/0.93/
      DATA TDFAST/0.85/
      DATA WAKFAC/0.98/
      DATA XILD1/7290./
      DATA XILD2/9580./
      DATA XKP/550./
      DATA XNEO/2./
C
      END
```

NOMENCLATURE: REVERSE TURBINE COMPUTER PROGRAM

ADVR	ADVANCE RATIO.
ANPROP	ABSOLUTE VALUE OF PROPELLER SPEED, RPM.
CQ	PROPELLER TORQUE COEFFICIENT.
CQ1TAB	TABLE OF CQ'S FOR AHEAD QUADRANT.
CQ2TAB	TABLE OF CQ'S FOR CRASHBACK QUADRANT.
CQ3TAB	TABLE OF CQ'S FOR BACKING QUADRANT.
CQ4TAB	TABLE OF CQ'S FOR CRASHAHEAD QUADRANT.
CT	PROPELLER THRUST COEFFICIENT.
CT1TAB	TABLE OF CT'S FOR AHEAD QUADRANT.
CT2TAB	TABLE OF CT'S FOR CRASHBACK QUADRANT.
CT3TAB	TABLE OF CT'S FOR BACKING QUADRANT.
CT4TAB	TABLE OF CT'S FOR CRASHAHEAD QUADRANT.
DIAM	PROPELLER DIAMETER, FT.
DISPL	SHIP DISPLACEMENT INCLUDING ENTRAINED WATER, LBF*SEC**2/FT.
DNENG	DERIVATIVE OF ENGINE OUTPUT SPEED, RPM/SEC.
DRAGP	TOTAL SHIP RESISTANCE, LBF.
DVSHIP	DERIVATIVE OF SHIP VELOCITY, KNOTS/SEC.
ERRB	BASE ERROR.
ETAP	PROPELLER EFFICIENCY.
FMADVR	FIRST MODIFIED ADVANCE RATIO.
GC	GRAVITATIONAL CONSTANT, 32.17 LBM*FT/LBF*SEC**2.
GR	REDUCTION GEAR RATIO.
H2O	WATER DENSITY, 62.4 LBM/FT**3.
IPRT1	ON-OFF SWITCH FOR ITERATION PRINT STATMENTS.
IPRT2	ON-OFF SWITCH FOR STEADY-STATE PRINT STATEMENTS.
IPRT3	ON-OFF SWITCH FOR TRANSIENT PRINT STATEMENTS.
MODE	(MODE=1) IMPLIES STEADY-STATE CONDITION.
	(MODE=2) IMPLIES TRANSIENT CONDITION.
NMAX	NUMBER OF INDEPENDENT VARIABLES OR BASE ERRORS.
NPASS	ITERATION COUNTER DURING CONVERGENCE ATTEMPTS.
PI	CONSTANT, 3.1416.
PWRENG	ENGINE OUTPUT POWER, HP.
PWRLOSS	FRICTION LOSS OF POWER IN MECHANICAL TRANSMISSION, HP.
PWRPRP	PROPELLER POWER, HP.
REACH	SHIP'S HEAD REACH, FT.
SG1TAB	TABLE OF SMADVR'S FOR AHEAD QUADRANT.
SG2TAB	TABLE OF SMADVR'S FOR CRASHBACK QUADRADNT.
SG3TAB	TABLE OF SMADVR'S FOR BACKING QUADRANT.
SG4TAB	TABLE OF SMADVR'S FOR CRASHAHEAD QUADRANT.
SMADVR	SECOND MODIFIED ADVANCE RATIO.
SSE	SUM OF SQUARED ERRORS.
SWF	SCALED FUEL FLOW RATE, THOUSANDS OF LBM/HR.
SXNENG	SCALED ENGINE OUTPUT SPEED, THOUSANDS OF RPM.
THPN	NET PROPELLER THRUST, LBF.
THPROP	PROPELLER THRUST, LBF.
TIME	ELASPED TIME, SEC.
TOLER	TOLERANCE OF CONVERGENCE TESTS.
TQENG	ENGINE OUTPUT TORQUE, FT-LBF.
TQPROP	PROPELLER TORQUE, FT-LBF.
TSTEP	TIME INCREMENT DURING TRANSIENT, SEC.
UBHPPT	UNBALANCED HORSEPOWER PER ENGINE, HP.
VAR	INDEPENDENT VARIABLE.
VPROP	PROPELLER SPEED OF ADVANCE, FT/MIN.

```
VSHIP     SHIP VELOCITY, KNOTS.
VSOLD     SHIP VELOCITY DURING PREVIOUS TIME INCREMENT, KNOTS.
WF        FUEL FLOW RATE PER ENGINE, LBM/HR.
XI        DRIVE TRAIN INERTIA(XILD1 OR XILD2) REFERRED TO ENGINE
          OUTPUT SPEED, RPM.
XILD1     DRIVE TRAIN INERTIA FOR ONE ENGINE OPERATION, LBM-FT**2.
XILD2     DRIVE TRAIN INERTIA FOR TWO ENGINE OPERATION, LBM-FT**2.
XKP       MECHANICAL EQUIVALENT OF POWER, 550 FT-LBF/SEC/HP.
XNENG     ENGINE OUTPUT SPEED, RPM.
XNEO      NUMBER OF ENGINES OPERATING.
XNOLD     ENGINE OUTPUT SPEED DURING PREVIOUS TIME INCREMENT, RPM.
XNORM1    NORMALIZING VALUE USED IN POWER BALANCES.
XNORM2    NORMALIZING VALUE USED IN THRUST BALANCES.
XNPROP    PROPELLER ROTATIONAL SPEED, RPM.
 82 CARDS REPRODUCED

CARDS PUNCHED     81
```

APPENDIX D

SAMPLE OF A STEADY-STATE CALCULATION
AND
A TRANSIENT CRASHBACK SIMULATION

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```
STEADY-STATE AHEAD PERFORMANCE      POINT NUMBER  1

SOLUTION CONVERGENCE ATTEMPTED

NPASS=  1      VAR(1)=  4000.           VAR(2)=  30.00
               ERRB(1)= -.689E+00       ERRB(2)=  .959E+00
               SSE=  .139E+01
               NEW EMAT CALCULATED
               VECM(1)= -.346E+03       VECM(2)= -.957E-01
               VRATIO=  .100E+01
NPASS=  2      VAR(1)=  3654.           VAR(2)=  29.90
               ERRB(1)= -.756E-01       ERRB(2)=  .593E-01
               SSE=  .923E-02
               VECM(1)= -.443E+02       VECM(2)= -.174E+00
               VRATIO=  .100E+01
NPASS=  3      VAR(1)=  3609.           VAR(2)=  29.73
               ERRB(1)= -.187E-01       ERRB(2)=  .130E-01
               SSE=  .519E-03
               VECM(1)= -.105E-02       VECM(2)=  .515E-02
               VRATIO=  .100E+01
NPASS=  4      VAR(1)=  3609.           VAR(2)=  29.74
               ERRB(1)= -.184E-01       ERRB(2)=  .110E-01
               SSE=  .459E-03
               NEW EMAT CALCULATED
               VECM(1)= -.153E+02       VECM(2)= -.725E-01
               VRATIO=  .100E+01
NPASS=  5      VAR(1)=  3594.           VAR(2)=  29.66
               ERRB(1)= -.942E-04       ERRB(2)=  .396E-04
               SSE=  .105E-07

SOLUTION CONVERGENCE OBTAINED

               WF       FUEL FLOWRATE PER ENGINE          .8600E+04 (LBS/HR)
               XNENG    ENGINE OUTPUT SPEED               .3594E+04 (RPM)
               TQENG    ENGINE OUTPUT TORQUE              .3127E+05 (FT-LBF)
               PWRENG   ENGINE OUTPUT POWER               .2140E+05 (HP)
               PWRLOSS  MECH.TRANSMISSION LOSSES          .1660E+04 (HP)
               VSHIP    SHIP VELOCITY                     .2966E+02 (KNOTS)
               XNPROP   PROPELLER ROTATIONAL SPEED        .2105E+03 (RPM)
               VPROP    PROPELLER SPEED OF ADVANCE        .2944E+04 (FT/MIN)
               ADVR     ADVANCE RATIO                     .3854E+00
               FMADVR   FIRST MODIFIED ADVANCE RATIO      .3596E+00
               SMADVR   SECOND MODIFIED ADVANCE RATIO     .9331E+00
               CQ       PROPELLER TORQUE COEFFICIENT      .7802E-01
               CT       PROPELLER THRUST COEFFICIENT      .4082E+00
               THPROP   PROPELLER THRUST                  .3255E+06 (LBF)
               DRAGP    TOTAL SHIP RESISTANCE             .3027E+06 (LBF)
               THPN     NET PROPELLER THRUST              .5946E+01 (LBF)
               TQPROP   PROPELLER TORQUE                  .1027E+07 (FT-LBF)
               PWRPRP   PROPELLER POWER                   .4115E+05 (HP)
               ETAP     PROPELLER EFFICIENCY              .7058E+00
```

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
0.	.3594E+04	.2966E+02	.3127E+05	.2140E+05	.2105E+03	.9331E+00	.3255E+06	.1027E+07	0.
.1000E+00	.3588E+04	.2966E+02	.3008E+05	.2055E+05	.2101E+03	.9329E+00	.3230E+06	.1020E+07	.5007E+01
.2000E+00	.3579E+04	.2966E+02	.2946E+05	.2008E+05	.2096E+03	.9326E+00	.3197E+06	.1010E+07	.1001E+02
.3000E+00	.3569E+04	.2966E+02	.2885E+05	.1960E+05	.2090E+03	.9323E+00	.3158E+06	.9990E+06	.1502E+02
.4000E+00	.3557E+04	.2966E+02	.2823E+05	.1912E+05	.2083E+03	.9319E+00	.3113E+06	.9863E+06	.2002E+02
.5000E+00	.3544E+04	.2965E+02	.2762E+05	.1864E+05	.2076E+03	.9314E+00	.3063E+06	.9723E+06	.2503E+02
.6000E+00	.3530E+04	.2965E+02	.2701E+05	.1815E+05	.2067E+03	.9310E+00	.3011E+06	.9573E+06	.3003E+02
.7000E+00	.3515E+04	.2964E+02	.2639E+05	.1767E+05	.2059E+03	.9304E+00	.2955E+06	.9414E+06	.3504E+02
.8000E+00	.3499E+04	.2963E+02	.2578E+05	.1718E+05	.2049E+03	.9299E+00	.2896E+06	.9249E+06	.4004E+02
.9000E+00	.3483E+04	.2963E+02	.2517E+05	.1669E+05	.2040E+03	.9294E+00	.2836E+06	.9078E+06	.4504E+02
.1000E+01	.3466E+04	.2962E+02	.2455E+05	.1620E+05	.2030E+03	.9288E+00	.2774E+06	.8902E+06	.5004E+02
.1100E+01	.3448E+04	.2961E+02	.2394E+05	.1572E+05	.2020E+03	.9282E+00	.2711E+06	.8722E+06	.5504E+02
.1200E+01	.3430E+04	.2959E+02	.2332E+05	.1523E+05	.2009E+03	.9275E+00	.2647E+06	.8540E+06	.6003E+02
.1300E+01	.3412E+04	.2958E+02	.2271E+05	.1475E+05	.1998E+03	.9269E+00	.2582E+06	.8355E+06	.6503E+02
.1400E+01	.3393E+04	.2957E+02	.2210E+05	.1428E+05	.1987E+03	.9262E+00	.2516E+06	.8168E+06	.7002E+02
.1500E+01	.3374E+04	.2955E+02	.2148E+05	.1380E+05	.1976E+03	.9256E+00	.2450E+06	.7979E+06	.7501E+02
.1600E+01	.3355E+04	.2953E+02	.2087E+05	.1333E+05	.1965E+03	.9249E+00	.2385E+06	.7789E+06	.8000E+02
.1700E+01	.3335E+04	.2952E+02	.2026E+05	.1286E+05	.1953E+03	.9242E+00	.2320E+06	.7599E+06	.8498E+02
.1800E+01	.3315E+04	.2950E+02	.1964E+05	.1240E+05	.1942E+03	.9235E+00	.2254E+06	.7407E+06	.8996E+02
.1900E+01	.3295E+04	.2948E+02	.1903E+05	.1194E+05	.1930E+03	.9227E+00	.2189E+06	.7215E+06	.9494E+02
.2000E+01	.3275E+04	.2946E+02	.1841E+05	.1148E+05	.1918E+03	.9220E+00	.2123E+06	.7022E+06	.9991E+02
.2100E+01	.3254E+04	.2943E+02	.1780E+05	.1103E+05	.1906E+03	.9212E+00	.2057E+06	.6828E+06	.1049E+03
.2200E+01	.3233E+04	.2941E+02	.1719E+05	.1058E+05	.1893E+03	.9204E+00	.1991E+06	.6635E+06	.1098E+03
.2300E+01	.3212E+04	.2938E+02	.1657E+05	.1014E+05	.1881E+03	.9196E+00	.1925E+06	.6441E+06	.1148E+03
.2400E+01	.3191E+04	.2936E+02	.1596E+05	.9695E+04	.1869E+03	.9188E+00	.1858E+06	.6247E+06	.1198E+03
.2500E+01	.3169E+04	.2933E+02	.1535E+05	.9259E+04	.1856E+03	.9179E+00	.1792E+06	.6054E+06	.1247E+03
.2600E+01	.3147E+04	.2930E+02	.1473E+05	.8827E+04	.1843E+03	.9171E+00	.1727E+06	.5860E+06	.1297E+03
.2700E+01	.3125E+04	.2927E+02	.1412E+05	.8399E+04	.1830E+03	.9162E+00	.1662E+06	.5680E+06	.1346E+03
.2800E+01	.3102E+04	.2924E+02	.1350E+05	.7976E+04	.1817E+03	.9152E+00	.1596E+06	.5492E+06	.1395E+03
.2900E+01	.3079E+04	.2921E+02	.1289E+05	.7557E+04	.1803E+03	.9143E+00	.1531E+06	.5302E+06	.1445E+03
.3000E+01	.3056E+04	.2918E+02	.1228E+05	.7143E+04	.1790E+03	.9133E+00	.1464E+06	.5112E+06	.1494E+03
.3100E+01	.3032E+04	.2914E+02	.1166E+05	.6733E+04	.1776E+03	.9123E+00	.1398E+06	.4922E+06	.1543E+03
.3200E+01	.3008E+04	.2911E+02	.1105E+05	.6329E+04	.1762E+03	.9113E+00	.1332E+06	.4731E+06	.1592E+03
.3300E+01	.2984E+04	.2907E+02	.1043E+05	.5929E+04	.1748E+03	.9102E+00	.1266E+06	.4540E+06	.1642E+03
.3400E+01	.2960E+04	.2903E+02	.9821E+04	.5535E+04	.1733E+03	.9092E+00	.1205E+06	.4351E+06	.1691E+03
.3500E+01	.2935E+04	.2899E+02	.9207E+04	.5145E+04	.1719E+03	.9080E+00	.1144E+06	.4162E+06	.1739E+03
.3600E+01	.2910E+04	.2895E+02	.8593E+04	.4761E+04	.1704E+03	.9069E+00	.1083E+06	.3972E+06	.1788E+03
.3700E+01	.2885E+04	.2891E+02	.7979E+04	.4383E+04	.1689E+03	.9057E+00	.1021E+06	.3782E+06	.1837E+03
.3800E+01	.2859E+04	.2887E+02	.7366E+04	.4010E+04	.1674E+03	.9045E+00	.9601E+05	.3591E+06	.1886E+03
.3900E+01	.2833E+04	.2883E+02	.6752E+04	.3642E+04	.1659E+03	.9032E+00	.8988E+05	.3401E+06	.1935E+03
.4000E+01	.2807E+04	.2879E+02	.6138E+04	.3280E+04	.1644E+03	.9019E+00	.8372E+05	.3210E+06	.1983E+03
.4100E+01	.2781E+04	.2874E+02	.5524E+04	.2925E+04	.1628E+03	.9006E+00	.7727E+05	.3013E+06	.2032E+03
.4200E+01	.2754E+04	.2870E+02	.4910E+04	.2575E+04	.1613E+03	.8992E+00	.7086E+05	.2818E+06	.2080E+03
.4300E+01	.2727E+04	.2865E+02	.4297E+04	.2231E+04	.1597E+03	.8978E+00	.6446E+05	.2623E+06	.2129E+03
.4400E+01	.2700E+04	.2860E+02	.3683E+04	.1893E+04	.1581E+03	.8963E+00	.5809E+05	.2429E+06	.2177E+03
.4500E+01	.2673E+04	.2855E+02	.3069E+04	.1562E+04	.1565E+03	.8948E+00	.5174E+05	.2236E+06	.2225E+03
.4600E+01	.2645E+04	.2851E+02	.2455E+04	.1237E+04	.1549E+03	.8933E+00	.4541E+05	.2043E+06	.2273E+03
.4700E+01	.2618E+04	.2846E+02	.1841E+04	.9177E+03	.1533E+03	.8917E+00	.3926E+05	.1858E+06	.2322E+03
.4800E+01	.2589E+04	.2840E+02	.1228E+04	.6052E+03	.1516E+03	.8900E+00	.3324E+05	.1678E+06	.2369E+03
.4900E+01	.2560E+04	.2835E+02	.6138E+03	.2992E+03	.1499E+03	.8882E+00	.2718E+05	.1497E+06	.2417E+03
.5000E+01	.2531E+04	.2830E+02	.1526E-08	.7356E-09	.1482E+03	.8864E+00	.2109E+05	.1315E+06	.2465E+03
.5100E+01	.2505E+04	.2825E+02	0.	0.	.1467E+03	.8848E+00	.1581E+05	.1158E+06	.2513E+03
.5200E+01	.2481E+04	.2819E+02	0.	0.	.1453E+03	.8833E+00	.1123E+05	.1020E+06	.2561E+03
.5300E+01	.2460E+04	.2814E+02	0.	0.	.1440E+03	.8820E+00	.7255E+04	.9087E+05	.2608E+03
.5400E+01	.2440E+04	.2808E+02	0.	0.	.1429E+03	.8809E+00	.4971E+04	.7969E+05	.2656E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.5500E+01	.2423E+04	.2803E+02	0.	0.	.1419E+03	.8798E+00	.3221E+04	.7861E+05	.2703E+03
.5600E+01	.2407E+04	.2797E+02	0.	0.	.1409E+03	.8789E+00	.1688E+04	.6264E+05	.2750E+03
.5700E+01	.2392E+04	.2792E+02	0.	0.	.1401E+03	.8780E+00	.3456E+03	.5562E+05	.2797E+03
.5800E+01	.2378E+04	.2786E+02	0.	0.	.1393E+03	.8773E+00	-.1966E+04	.4855E+05	.2844E+03
.5900E+01	.2366E+04	.2781E+02	0.	0.	.1386E+03	.8766E+00	-.4359E+04	.4212E+05	.2891E+03
.6000E+01	.2355E+04	.2775E+02	0.	0.	.1379E+03	.8761E+00	-.6397E+04	.3661E+05	.2938E+03
.6100E+01	.2345E+04	.2770E+02	0.	0.	.1373E+03	.8756E+00	-.8136E+04	.3188E+05	.2985E+03
.6200E+01	.2335E+04	.2764E+02	0.	0.	.1368E+03	.8752E+00	-.9619E+04	.2782E+05	.3032E+03
.6300E+01	.2327E+04	.2759E+02	0.	0.	.1363E+03	.8748E+00	-.1088E+05	.2433E+05	.3078E+03
.6400E+01	.2319E+04	.2753E+02	0.	0.	.1358E+03	.8745E+00	-.1196E+05	.2131E+05	.3125E+03
.6500E+01	.2311E+04	.2748E+02	0.	0.	.1353E+03	.8742E+00	-.1288E+05	.1872E+05	.3171E+03
.6600E+01	.2304E+04	.2743E+02	0.	0.	.1349E+03	.8740E+00	-.1367E+05	.1647E+05	.3218E+03
.6700E+01	.2297E+04	.2737E+02	0.	0.	.1345E+03	.8738E+00	-.1433E+05	.1453E+05	.3264E+03
.6800E+01	.2290E+04	.2732E+02	0.	0.	.1341E+03	.8736E+00	-.1490E+05	.1285E+05	.3310E+03
.6900E+01	.2284E+04	.2726E+02	0.	0.	.1338E+03	.8734E+00	-.1539E+05	.1139E+05	.3356E+03
.7000E+01	.2278E+04	.2721E+02	0.	0.	.1334E+03	.8733E+00	-.1580E+05	.1012E+05	.3402E+03
.7100E+01	.2272E+04	.2716E+02	0.	0.	.1331E+03	.8732E+00	-.1615E+05	.9019E+04	.3448E+03
.7200E+01	.2267E+04	.2711E+02	0.	0.	.1328E+03	.8731E+00	-.1644E+05	.8055E+04	.3494E+03
.7300E+01	.2261E+04	.2705E+02	0.	0.	.1324E+03	.8730E+00	-.1669E+05	.7211E+04	.3539E+03
.7400E+01	.2256E+04	.2700E+02	0.	0.	.1321E+03	.8729E+00	-.1690E+05	.6471E+04	.3585E+03
.7500E+01	.2251E+04	.2695E+02	0.	0.	.1318E+03	.8728E+00	-.1708E+05	.5821E+04	.3631E+03
.7600E+01	.2243E+04	.2690E+02	-.5000E+03	-.2136E+03	.1314E+03	.8725E+00	-.1807E+05	.3048E+04	.3676E+03
.7700E+01	.2233E+04	.2685E+02	-.1000E+04	-.4252E+03	.1308E+03	.8720E+00	-.1976E+05	-.1547E+04	.3721E+03
.7800E+01	.2221E+04	.2679E+02	-.1500E+04	-.6343E+03	.1301E+03	.8712E+00	-.2206E+05	-.7703E+04	.3767E+03
.7900E+01	.2207E+04	.2674E+02	-.2000E+04	-.8404E+03	.1293E+03	.8703E+00	-.2487E+05	-.1519E+05	.3812E+03
.8000E+01	.2191E+04	.2669E+02	-.2500E+04	-.1043E+04	.1283E+03	.8692E+00	-.2796E+05	-.2380E+05	.3857E+03
.8100E+01	.2175E+04	.2664E+02	-.3000E+04	-.1242E+04	.1274E+03	.8680E+00	-.3036E+05	-.3324E+05	.3902E+03
.8200E+01	.2156E+04	.2658E+02	-.3500E+04	-.1437E+04	.1263E+03	.8666E+00	-.3299E+05	-.4352E+05	.3947E+03
.8300E+01	.2137E+04	.2653E+02	-.4000E+04	-.1628E+04	.1252E+03	.8651E+00	-.3580E+05	-.5452E+05	.3992E+03
.8400E+01	.2117E+04	.2648E+02	-.4500E+04	-.1814E+04	.1240E+03	.8635E+00	-.3878E+05	-.6614E+05	.4036E+03
.8500E+01	.2096E+04	.2642E+02	-.5000E+04	-.1995E+04	.1227E+03	.8617E+00	-.4190E+05	-.7829E+05	.4081E+03
.8600E+01	.2074E+04	.2637E+02	-.5500E+04	-.2172E+04	.1215E+03	.8598E+00	-.4514E+05	-.9088E+05	.4126E+03
.8700E+01	.2051E+04	.2632E+02	-.6000E+04	-.2343E+04	.1201E+03	.8578E+00	-.4848E+05	-.1038E+06	.4170E+03
.8800E+01	.2028E+04	.2626E+02	-.6500E+04	-.2510E+04	.1188E+03	.8557E+00	-.5190E+05	-.1171E+06	.4214E+03
.8900E+01	.2004E+04	.2621E+02	-.7000E+04	-.2671E+04	.1174E+03	.8534E+00	-.5505E+05	-.1309E+06	.4259E+03
.9000E+01	.1980E+04	.2615E+02	-.7500E+04	-.2827E+04	.1159E+03	.8510E+00	-.5816E+05	-.1449E+06	.4303E+03
.9100E+01	.1955E+04	.2610E+02	-.8000E+04	-.2977E+04	.1145E+03	.8485E+00	-.6132E+05	-.1590E+06	.4347E+03
.9200E+01	.1929E+04	.2604E+02	-.8500E+04	-.3122E+04	.1130E+03	.8459E+00	-.6450E+05	-.1733E+06	.4391E+03
.9300E+01	.1903E+04	.2599E+02	-.9000E+04	-.3261E+04	.1115E+03	.8432E+00	-.6772E+05	-.1878E+06	.4435E+03
.9400E+01	.1877E+04	.2593E+02	-.9500E+04	-.3395E+04	.1099E+03	.8403E+00	-.7097E+05	-.2023E+06	.4479E+03
.9500E+01	.1850E+04	.2587E+02	-.1000E+05	-.3522E+04	.1083E+03	.8372E+00	-.7405E+05	-.2166E+06	.4522E+03
.9600E+01	.1823E+04	.2582E+02	-.1050E+05	-.3644E+04	.1067E+03	.8340E+00	-.7696E+05	-.2305E+06	.4566E+03
.9700E+01	.1795E+04	.2576E+02	-.1100E+05	-.3759E+04	.1051E+03	.8306E+00	-.7989E+05	-.2446E+06	.4610E+03
.9800E+01	.1766E+04	.2570E+02	-.1150E+05	-.3867E+04	.1034E+03	.8271E+00	-.8286E+05	-.2588E+06	.4653E+03
.9900E+01	.1737E+04	.2565E+02	-.1200E+05	-.3970E+04	.1017E+03	.8233E+00	-.8584E+05	-.2731E+06	.4696E+03
.1000E+02	.1708E+04	.2559E+02	-.1250E+05	-.4065E+04	.1000E+03	.8193E+00	-.8883E+05	-.2876E+06	.4740E+03
.1010E+02	.1678E+04	.2553E+02	-.1300E+05	-.4154E+04	.9829E+02	.8152E+00	-.9117E+05	-.3030E+06	.4783E+03
.1020E+02	.1648E+04	.2547E+02	-.1350E+05	-.4237E+04	.9653E+02	.8109E+00	-.9351E+05	-.3184E+06	.4826E+03
.1030E+02	.1618E+04	.2542E+02	-.1400E+05	-.4313E+04	.9476E+02	.8063E+00	-.9585E+05	-.3338E+06	.4869E+03
.1040E+02	.1588E+04	.2536E+02	-.1450E+05	-.4383E+04	.9297E+02	.8015E+00	-.9819E+05	-.3492E+06	.4912E+03
.1050E+02	.1557E+04	.2530E+02	-.1500E+05	-.4446E+04	.9117E+02	.7965E+00	-.1005E+06	-.3646E+06	.4954E+03
.1060E+02	.1526E+04	.2524E+02	-.1550E+05	-.4503E+04	.8936E+02	.7913E+00	-.1022E+06	-.3800E+06	.4997E+03
.1070E+02	.1494E+04	.2518E+02	-.1600E+05	-.4553E+04	.8752E+02	.7858E+00	-.1040E+06	-.3955E+06	.5040E+03
.1080E+02	.1463E+04	.2513E+02	-.1650E+05	-.4596E+04	.8568E+02	.7801E+00	-.1058E+06	-.4109E+06	.5082E+03
.1090E+02	.1431E+04	.2507E+02	-.1700E+05	-.4632E+04	.8381E+02	.7740E+00	-.1076E+06	-.4264E+06	.5124E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.1100E+02	.1398E+04	.2501E+02	-.1750E+05	-.4660E+04	.8190E+02	.7675E+00	-.1093E+06	-.4402E+06	.5167E+03
.1110E+02	.1365E+04	.2495E+02	-.1800E+05	-.4678E+04	.7994E+02	.7605E+00	-.1110E+06	-.4524E+06	.5209E+03
.1120E+02	.1331E+04	.2489E+02	-.1850E+05	-.4687E+04	.7793E+02	.7531E+00	-.1127E+06	-.4650E+06	.5251E+03
.1130E+02	.1296E+04	.2484E+02	-.1900E+05	-.4687E+04	.7588E+02	.7451E+00	-.1144E+06	-.4777E+06	.5293E+03
.1140E+02	.1260E+04	.2478E+02	-.1950E+05	-.4678E+04	.7379E+02	.7365E+00	-.1156E+06	-.4912E+06	.5335E+03
.1150E+02	.1224E+04	.2472E+02	-.2000E+05	-.4660E+04	.7167E+02	.7274E+00	-.1159E+06	-.5056E+06	.5376E+03
.1160E+02	.1187E+04	.2466E+02	-.2050E+05	-.4634E+04	.6952E+02	.7177E+00	-.1162E+06	-.5202E+06	.5418E+03
.1170E+02	.1150E+04	.2461E+02	-.2100E+05	-.4599E+04	.6735E+02	.7074E+00	-.1165E+06	-.5349E+06	.5460E+03
.1180E+02	.1113E+04	.2455E+02	-.2150E+05	-.4555E+04	.6517E+02	.6965E+00	-.1158E+06	-.5503E+06	.5501E+03
.1190E+02	.1075E+04	.2449E+02	-.2200E+05	-.4504E+04	.6297E+02	.6849E+00	-.1144E+06	-.5661E+06	.5543E+03
.1200E+02	.1038E+04	.2444E+02	-.2250E+05	-.4445E+04	.6076E+02	.6727E+00	-.1131E+06	-.5820E+06	.5584E+03
.1210E+02	.9996E+03	.2438E+02	-.2300E+05	-.4377E+04	.5854E+02	.6597E+00	-.1119E+06	-.5976E+06	.5625E+03
.1220E+02	.9605E+03	.2433E+02	-.2350E+05	-.4298E+04	.5625E+02	.6456E+00	-.1099E+06	-.6083E+06	.5666E+03
.1230E+02	.9203E+03	.2427E+02	-.2400E+05	-.4206E+04	.5390E+02	.6303E+00	-.1080E+06	-.6196E+06	.5707E+03
.1240E+02	.8792E+03	.2422E+02	-.2450E+05	-.4102E+04	.5149E+02	.6137E+00	-.1062E+06	-.6315E+06	.5748E+03
.1250E+02	.8367E+03	.2417E+02	-.2500E+05	-.3983E+04	.4900E+02	.5955E+00	-.1074E+06	-.6404E+06	.5789E+03
.1260E+02	.7956E+03	.2411E+02	-.2500E+05	-.3787E+04	.4660E+02	.5770E+00	-.1093E+06	-.6483E+06	.5830E+03
.1270E+02	.7561E+03	.2406E+02	-.2500E+05	-.3599E+04	.4428E+02	.5583E+00	-.1112E+06	-.6563E+06	.5870E+03
.1280E+02	.7189E+03	.2401E+02	-.2500E+05	-.3422E+04	.4210E+02	.5398E+00	-.1142E+06	-.6680E+06	.5911E+03
.1290E+02	.6842E+03	.2395E+02	-.2500E+05	-.3257E+04	.4007E+02	.5218E+00	-.1178E+06	-.6814E+06	.5951E+03
.1300E+02	.6518E+03	.2390E+02	-.2500E+05	-.3103E+04	.3818E+02	.5043E+00	-.1211E+06	-.6939E+06	.5992E+03
.1310E+02	.6218E+03	.2384E+02	-.2500E+05	-.2960E+04	.3641E+02	.4875E+00	-.1242E+06	-.7056E+06	.6032E+03
.1320E+02	.5929E+03	.2379E+02	-.2500E+05	-.2822E+04	.3472E+02	.4708E+00	-.1263E+06	-.7120E+06	.6072E+03
.1330E+02	.5648E+03	.2373E+02	-.2500E+05	-.2689E+04	.3308E+02	.4540E+00	-.1279E+06	-.7160E+06	.6112E+03
.1340E+02	.5376E+03	.2368E+02	-.2500E+05	-.2559E+04	.3148E+02	.4372E+00	-.1296E+06	-.7202E+06	.6152E+03
.1350E+02	.5111E+03	.2362E+02	-.2500E+05	-.2433E+04	.2994E+02	.4204E+00	-.1312E+06	-.7245E+06	.6192E+03
.1360E+02	.4856E+03	.2357E+02	-.2500E+05	-.2312E+04	.2844E+02	.4037E+00	-.1327E+06	-.7259E+06	.6232E+03
.1370E+02	.4602E+03	.2351E+02	-.2500E+05	-.2190E+04	.2695E+02	.3865E+00	-.1319E+06	-.7293E+06	.6272E+03
.1380E+02	.4349E+03	.2346E+02	-.2500E+05	-.2070E+04	.2547E+02	.3690E+00	-.1309E+06	-.7300E+06	.6311E+03
.1390E+02	.4098E+03	.2340E+02	-.2500E+05	-.1951E+04	.2400E+02	.3511E+00	-.1301E+06	-.7310E+06	.6351E+03
.1400E+02	.3851E+03	.2335E+02	-.2500E+05	-.1833E+04	.2255E+02	.3330E+00	-.1293E+06	-.7326E+06	.6390E+03
.1410E+02	.3607E+03	.2329E+02	-.2500E+05	-.1717E+04	.2113E+02	.3147E+00	-.1287E+06	-.7345E+06	.6430E+03
.1420E+02	.3377E+03	.2324E+02	-.2500E+05	-.1607E+04	.1978E+02	.2971E+00	-.1281E+06	-.7414E+06	.6469E+03
.1430E+02	.3160E+03	.2319E+02	-.2500E+05	-.1504E+04	.1851E+02	.2802E+00	-.1275E+06	-.7484E+06	.6508E+03
.1440E+02	.2957E+03	.2313E+02	-.2500E+05	-.1407E+04	.1732E+02	.2640E+00	-.1271E+06	-.7552E+06	.6547E+03
.1450E+02	.2765E+03	.2308E+02	-.2500E+05	-.1316E+04	.1620E+02	.2485E+00	-.1266E+06	-.7616E+06	.6586E+03
.1460E+02	.2586E+03	.2303E+02	-.2500E+05	-.1231E+04	.1514E+02	.2338E+00	-.1263E+06	-.7677E+06	.6625E+03
.1470E+02	.2417E+03	.2297E+02	-.2500E+05	-.1151E+04	.1416E+02	.2198E+00	-.1259E+06	-.7735E+06	.6664E+03
.1480E+02	.2242E+03	.2292E+02	-.2500E+05	-.1067E+04	.1313E+02	.2050E+00	-.1245E+06	-.7699E+06	.6703E+03
.1490E+02	.2051E+03	.2287E+02	-.2500E+05	-.9762E+03	.1201E+02	.1885E+00	-.1223E+06	-.7612E+06	.6741E+03
.1491E+02	.2031E+03	.2287E+02	-.2500E+05	-.9670E+03	.1190E+02	.1869E+00	-.1221E+06	-.7604E+06	.6745E+03
.1492E+02	.2012E+03	.2286E+02	-.2500E+05	-.9577E+03	.1178E+02	.1852E+00	-.1219E+06	-.7595E+06	.6749E+03
.1493E+02	.1992E+03	.2286E+02	-.2500E+05	-.9484E+03	.1167E+02	.1835E+00	-.1217E+06	-.7587E+06	.6753E+03
.1494E+02	.1973E+03	.2285E+02	-.2500E+05	-.9390E+03	.1155E+02	.1818E+00	-.1215E+06	-.7578E+06	.6757E+03
.1495E+02	.1953E+03	.2285E+02	-.2500E+05	-.9295E+03	.1144E+02	.1800E+00	-.1213E+06	-.7570E+06	.6761E+03
.1496E+02	.1933E+03	.2284E+02	-.2500E+05	-.9200E+03	.1132E+02	.1783E+00	-.1211E+06	-.7562E+06	.6765E+03
.1497E+02	.1912E+03	.2284E+02	-.2500E+05	-.9104E+03	.1120E+02	.1765E+00	-.1209E+06	-.7553E+06	.6768E+03
.1498E+02	.1892E+03	.2283E+02	-.2500E+05	-.9007E+03	.1108E+02	.1747E+00	-.1207E+06	-.7545E+06	.6772E+03
.1499E+02	.1872E+03	.2283E+02	-.2500E+05	-.8909E+03	.1096E+02	.1729E+00	-.1204E+06	-.7537E+06	.6776E+03
.1500E+02	.1851E+03	.2282E+02	-.2500E+05	-.8811E+03	.1084E+02	.1711E+00	-.1202E+06	-.7528E+06	.6780E+03
.1501E+02	.1830E+03	.2282E+02	-.2500E+05	-.8711E+03	.1072E+02	.1693E+00	-.1200E+06	-.7520E+06	.6784E+03
.1502E+02	.1809E+03	.2281E+02	-.2500E+05	-.8612E+03	.1060E+02	.1674E+00	-.1198E+06	-.7512E+06	.6788E+03
.1503E+02	.1788E+03	.2280E+02	-.2500E+05	-.8511E+03	.1047E+02	.1656E+00	-.1196E+06	-.7504E+06	.6792E+03
.1504E+02	.1767E+03	.2280E+02	-.2500E+05	-.8410E+03	.1035E+02	.1637E+00	-.1194E+06	-.7495E+06	.6795E+03
.1505E+02	.1745E+03	.2279E+02	-.2500E+05	-.8308E+03	.1022E+02	.1618E+00	-.1192E+06	-.7487E+06	.6799E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.1506E+02	.1724E+03	.2279E+02	-.2500E+05	-.8205E+03	.1009E+02	.1599E+00	-.1190E+06	-.7479E+06	.6803E+03
.1507E+02	.1702E+03	.2278E+02	-.2500E+05	-.8102E+03	.9968E+01	.1579E+00	-.1187E+06	-.7471E+06	.6807E+03
.1508E+02	.1680E+03	.2278E+02	-.2500E+05	-.7998E+03	.9840E+01	.1560E+00	-.1185E+06	-.7463E+06	.6811E+03
.1509E+02	.1658E+03	.2277E+02	-.2500E+05	-.7893E+03	.9711E+01	.1540E+00	-.1183E+06	-.7455E+06	.6815E+03
.1510E+02	.1636E+03	.2277E+02	-.2500E+05	-.7787E+03	.9581E+01	.1521E+00	-.1181E+06	-.7447E+06	.6819E+03
.1511E+02	.1614E+03	.2276E+02	-.2500E+05	-.7681E+03	.9450E+01	.1501E+00	-.1179E+06	-.7439E+06	.6822E+03
.1512E+02	.1591E+03	.2276E+02	-.2500E+05	-.7574E+03	.9319E+01	.1481E+00	-.1177E+06	-.7431E+06	.6826E+03
.1513E+02	.1569E+03	.2275E+02	-.2500E+05	-.7466E+03	.9186E+01	.1460E+00	-.1175E+06	-.7423E+06	.6830E+03
.1514E+02	.1546E+03	.2275E+02	-.2500E+05	-.7358E+03	.9053E+01	.1440E+00	-.1173E+06	-.7415E+06	.6834E+03
.1515E+02	.1523E+03	.2274E+02	-.2500E+05	-.7249E+03	.8919E+01	.1419E+00	-.1170E+06	-.7408E+06	.6838E+03
.1516E+02	.1500E+03	.2274E+02	-.2500E+05	-.7139E+03	.8784E+01	.1398E+00	-.1168E+06	-.7400E+06	.6842E+03
.1517E+02	.1477E+03	.2273E+02	-.2500E+05	-.7029E+03	.8648E+01	.1378E+00	-.1166E+06	-.7392E+06	.6845E+03
.1518E+02	.1453E+03	.2273E+02	-.2500E+05	-.6918E+03	.8512E+01	.1357E+00	-.1164E+06	-.7384E+06	.6849E+03
.1519E+02	.1430E+03	.2272E+02	-.2500E+05	-.6806E+03	.8374E+01	.1335E+00	-.1162E+06	-.7377E+06	.6853E+03
.1520E+02	.1406E+03	.2272E+02	-.2500E+05	-.6694E+03	.8236E+01	.1314E+00	-.1160E+06	-.7369E+06	.6857E+03
.1521E+02	.1383E+03	.2271E+02	-.2500E+05	-.6581E+03	.8097E+01	.1292E+00	-.1158E+06	-.7362E+06	.6861E+03
.1522E+02	.1359E+03	.2271E+02	-.2500E+05	-.6468E+03	.7957E+01	.1271E+00	-.1156E+06	-.7354E+05	.6865E+03
.1523E+02	.1335E+03	.2270E+02	-.2500E+05	-.6353E+03	.7817E+01	.1249E+00	-.1153E+06	-.7347E+06	.6868E+03
.1524E+02	.1311E+03	.2270E+02	-.2500E+05	-.6238E+03	.7675E+01	.1227E+00	-.1151E+06	-.7339E+06	.6872E+03
.1525E+02	.1286E+03	.2269E+02	-.2500E+05	-.6123E+03	.7533E+01	.1205E+00	-.1149E+06	-.7332E+06	.6876E+03
.1526E+02	.1262E+03	.2269E+02	-.2500E+05	-.6007E+03	.7390E+01	.1183E+00	-.1147E+06	-.7325E+06	.6880E+03
.1527E+02	.1237E+03	.2268E+02	-.2500E+05	-.5890E+03	.7246E+01	.1160E+00	-.1145E+06	-.7318E+06	.6884E+03
.1528E+02	.1213E+03	.2268E+02	-.2500E+05	-.5772E+03	.7102E+01	.1137E+00	-.1143E+06	-.7311E+06	.6888E+03
.1529E+02	.1188E+03	.2267E+02	-.2500E+05	-.5654E+03	.6957E+01	.1115E+00	-.1141E+06	-.7304E+06	.6891E+03
.1530E+02	.1163E+03	.2267E+02	-.2500E+05	-.5535E+03	.6810E+01	.1092E+00	-.1138E+06	-.7298E+06	.6895E+03
.1531E+02	.1135E+03	.2266E+02	-.2500E+05	-.5403E+03	.6647E+01	.1066E+00	-.1122E+06	-.7145E+06	.6899E+03
.1532E+02	.1104E+03	.2266E+02	-.2500E+05	-.5256E+03	.6467E+01	.1038E+00	-.1104E+06	-.6984E+06	.6903E+03
.1533E+02	.1070E+03	.2266E+02	-.2500E+05	-.5094E+03	.6267E+01	.1006E+00	-.1084E+06	-.6807E+05	.6907E+03
.1534E+02	.1032E+03	.2265E+02	-.2500E+05	-.4914E+03	.6046E+01	.9714E-01	-.1063E+06	-.6611E+06	.6910E+03
.1535E+02	.9906E+02	.2265E+02	-.2500E+05	-.4715E+03	.5801E+01	.9326E-01	-.1039E+06	-.6395E+06	.6914E+03
.1536E+02	.9443E+02	.2264E+02	-.2500E+05	-.4495E+03	.5530E+01	.8895E-01	-.1012E+06	-.6156E+06	.6918E+03
.1537E+02	.8930E+02	.2264E+02	-.2500E+05	-.4251E+03	.5230E+01	.8418E-01	-.9828E+05	-.5892E+06	.6922E+03
.1538E+02	.8363E+02	.2263E+02	-.2500E+05	-.3981E+03	.4898E+01	.7888E-01	-.9506E+05	-.5601E+06	.6926E+03
.1539E+02	.7736E+02	.2263E+02	-.2500E+05	-.3683E+03	.4531E+01	.7302E-01	-.9151E+05	-.5280E+06	.6930E+03
.1540E+02	.7043E+02	.2262E+02	-.2500E+05	-.3353E+03	.4125E+01	.6652E-01	-.8759E+05	-.4926E+06	.6933E+03
.1541E+02	.6277E+02	.2262E+02	-.2500E+05	-.2988E+03	.3676E+01	.5932E-01	-.8329E+05	-.4536E+06	.6937E+03
.1542E+02	.5430E+02	.2261E+02	-.2500E+05	-.2585E+03	.3180E+01	.5135E-01	-.7854E+05	-.4106E+06	.6941E+03
.1543E+02	.4495E+02	.2261E+02	-.2500E+05	-.2140E+03	.2633E+01	.4253E-01	-.7332E+05	-.3632E+06	.6945E+03
.1544E+02	.3463E+02	.2261E+02	-.2500E+05	-.1649E+03	.2028E+01	.3279E-01	-.6758E+05	-.3109E+06	.6949E+03
.1545E+02	.2325E+02	.2260E+02	-.2500E+05	-.1107E+03	.1362E+01	.2203E-01	-.6127E+05	-.2535E+06	.6953E+03
.1546E+02	.1076E+02	.2260E+02	-.2500E+05	-.5120E+02	.6300E+00	.1019E-01	-.5436E+05	-.1905E+06	.6956E+03
.1547E+02	-.2390E+01	.2259E+02	-.2500E+05	.1137E+02	-.1399E+00	-.2265E-02	-.5214E+05	-.1460E+06	.6960E+03
.1548E+02	-.1466E+02	.2259E+02	-.2500E+05	.6979E+02	-.8587E+00	-.1390E-01	-.7120E+05	-.1954E+06	.6964E+03
.1549E+02	-.2605E+02	.2259E+02	-.2500E+05	.1240E+03	-.1526E+01	-.2469E-01	-.8888E+05	-.2412E+06	.6968E+03
.1550E+02	-.3662E+02	.2258E+02	-.2500E+05	.1743E+03	-.2145E+01	-.3470E-01	-.1053E+06	-.2838E+06	.6972E+03
.1551E+02	-.4644E+02	.2258E+02	-.2500E+05	.2211E+03	-.2720E+01	-.4400E-01	-.1206E+06	-.3234E+06	.6975E+03
.1552E+02	-.5556E+02	.2257E+02	-.2500E+05	.2645E+03	-.3254E+01	-.5264E-01	-.1348E+06	-.3603E+06	.6979E+03
.1553E+02	-.6404E+02	.2257E+02	-.2500E+05	.3048E+03	-.3751E+01	-.6066E-01	-.1480E+06	-.3945E+06	.6983E+03
.1554E+02	-.7192E+02	.2256E+02	-.2500E+05	.3423E+03	-.4212E+01	-.6810E-01	-.1603E+06	-.4264E+06	.6987E+03
.1555E+02	-.7923E+02	.2255E+02	-.2500E+05	.3772E+03	-.4640E+01	-.7501E-01	-.1717E+06	-.4560E+06	.6991E+03
.1556E+02	-.8603E+02	.2255E+02	-.2500E+05	.4095E+03	-.5038E+01	-.8143E-01	-.1824E+06	-.4835E+06	.6994E+03
.1557E+02	-.9235E+02	.2254E+02	-.2500E+05	.4396E+03	-.5408E+01	-.8739E-01	-.1922E+06	-.5091E+06	.6998E+03
.1558E+02	-.9821E+02	.2253E+02	-.2500E+05	.4675E+03	-.5752E+01	-.9292E-01	-.2014E+06	-.5329E+06	.7002E+03
.1559E+02	-.1037E+03	.2253E+02	-.2500E+05	.4935E+03	-.6071E+01	-.9806E-01	-.2099E+06	-.5551E+06	.7006E+03
.1560E+02	-.1087E+03	.2252E+02	-.2500E+05	.5176E+03	-.6368E+01	-.1028E+00	-.2179E+06	-.5756E+06	.7010E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.1561E+02	-.1134E+03	.2251E+02	-.2500E+05	.5399E+03	-.6643E+01	-.1073E+00	-.2252E+06	-.5947E+06	.7013E+03
.1562E+02	-.1180E+03	.2251E+02	-.2500E+05	.5615E+03	-.6908E+01	-.1115E+00	-.2289E+06	-.6043E+06	.7017E+03
.1563E+02	-.1225E+03	.2250E+02	-.2500E+05	.5829E+03	-.7171E+01	-.1158E+00	-.2294E+06	-.6057E+06	.7021E+03
.1564E+02	-.1269E+03	.2249E+02	-.2500E+05	.6041E+03	-.7433E+01	-.1200E+00	-.2299E+06	-.6071E+06	.7025E+03
.1565E+02	-.1314E+03	.2249E+02	-.2500E+05	.6253E+03	-.7693E+01	-.1241E+00	-.2304E+06	-.6086E+06	.7029E+03
.1566E+02	-.1358E+03	.2248E+02	-.2500E+05	.6463E+03	-.7951E+01	-.1283E+00	-.2309E+06	-.6100E+06	.7032E+03
.1567E+02	-.1402E+03	.2247E+02	-.2500E+05	.6672E+03	-.8208E+01	-.1324E+00	-.2314E+06	-.6115E+06	.7036E+03
.1568E+02	-.1445E+03	.2246E+02	-.2500E+05	.6879E+03	-.8463E+01	-.1365E+00	-.2319E+06	-.6130E+06	.7040E+03
.1569E+02	-.1488E+03	.2246E+02	-.2500E+05	.7085E+03	-.8717E+01	-.1405E+00	-.2324E+06	-.6145E+06	.7044E+03
.1570E+02	-.1531E+03	.2245E+02	-.2500E+05	.7289E+03	-.8968E+01	-.1445E+00	-.2329E+06	-.6160E+06	.7048E+03
.1571E+02	-.1574E+03	.2244E+02	-.2500E+05	.7493E+03	-.9218E+01	-.1485E+00	-.2334E+06	-.6175E+06	.7051E+03
.1572E+02	-.1616E+03	.2244E+02	-.2500E+05	.7694E+03	-.9467E+01	-.1525E+00	-.2340E+06	-.6190E+06	.7055E+03
.1573E+02	-.1659E+03	.2243E+02	-.2500E+05	.7895E+03	-.9713E+01	-.1564E+00	-.2345E+06	-.6205E+06	.7059E+03
.1574E+02	-.1700E+03	.2242E+02	-.2500E+05	.8094E+03	-.9958E+01	-.1603E+00	-.2350E+06	-.6220E+06	.7063E+03
.1575E+02	-.1742E+03	.2242E+02	-.2500E+05	.8292E+03	-.1020E+02	-.1641E+00	-.2355E+06	-.6235E+06	.7067E+03
.1576E+02	-.1783E+03	.2241E+02	-.2500E+05	.8488E+03	-.1044E+02	-.1680E+00	-.2361E+06	-.6251E+06	.7070E+03
.1577E+02	-.1824E+03	.2240E+02	-.2500E+05	.8683E+03	-.1068E+02	-.1718E+00	-.2366E+06	-.6266E+06	.7074E+03
.1578E+02	-.1865E+03	.2239E+02	-.2500E+05	.8876E+03	-.1092E+02	-.1755E+00	-.2371E+06	-.6281E+06	.7078E+03
.1579E+02	-.1905E+03	.2239E+02	-.2500E+05	.9069E+03	-.1116E+02	-.1793E+00	-.2377E+06	-.6297E+06	.7082E+03
.1580E+02	-.1945E+03	.2238E+02	-.2500E+05	.9259E+03	-.1139E+02	-.1830E+00	-.2382E+06	-.6312E+06	.7085E+03
.1581E+02	-.1985E+03	.2237E+02	-.2500E+05	.9448E+03	-.1162E+02	-.1866E+00	-.2388E+06	-.6328E+06	.7089E+03
.1582E+02	-.2024E+03	.2236E+02	-.2500E+05	.9636E+03	-.1186E+02	-.1903E+00	-.2393E+06	-.6343E+06	.7093E+03
.1583E+02	-.2064E+03	.2236E+02	-.2500E+05	.9823E+03	-.1209E+02	-.1939E+00	-.2398E+06	-.6359E+06	.7097E+03
.1584E+02	-.2102E+03	.2235E+02	-.2500E+05	.1001E+04	-.1231E+02	-.1975E+00	-.2404E+06	-.6375E+06	.7101E+03
.1585E+02	-.2141E+03	.2234E+02	-.2500E+05	.1019E+04	-.1254E+02	-.2010E+00	-.2409E+06	-.6390E+06	.7104E+03
.1595E+02	-.2473E+03	.2227E+02	-.2500E+05	.1177E+04	-.1448E+02	-.2313E+00	-.2444E+06	-.6682E+06	.7142E+03
.1605E+02	-.2740E+03	.2220E+02	-.2500E+05	.1304E+04	-.1605E+02	-.2555E+00	-.2463E+06	-.7026E+06	.7179E+03
.1615E+02	-.2955E+03	.2213E+02	-.2500E+05	.1406E+04	-.1730E+02	-.2749E+00	-.2477E+06	-.7302E+06	.7217E+03
.1625E+02	-.3127E+03	.2205E+02	-.2500E+05	.1489E+04	-.1832E+02	-.2906E+00	-.2488E+06	-.7522E+06	.7254E+03
.1635E+02	-.3267E+03	.2198E+02	-.2500E+05	.1555E+04	-.1913E+02	-.3033E+00	-.2494E+06	-.7695E+06	.7291E+03
.1645E+02	-.3382E+03	.2191E+02	-.2500E+05	.1610E+04	-.1981E+02	-.3138E+00	-.2498E+06	-.7824E+06	.7328E+03
.1655E+02	-.3497E+03	.2184E+02	-.2500E+05	.1664E+04	-.2048E+02	-.3244E+00	-.2511E+06	-.7720E+06	.7365E+03
.1665E+02	-.3653E+03	.2176E+02	-.2500E+05	.1739E+04	-.2140E+02	-.3383E+00	-.2534E+06	-.7602E+06	.7402E+03
.1675E+02	-.3832E+03	.2169E+02	-.2500E+05	.1824E+04	-.2244E+02	-.3539E+00	-.2564E+06	-.7479E+06	.7439E+03
.1685E+02	-.4035E+03	.2162E+02	-.2500E+05	.1921E+04	-.2363E+02	-.3712E+00	-.2602E+06	-.7352E+06	.7475E+03
.1695E+02	-.4262E+03	.2154E+02	-.2500E+05	.2029E+04	-.2496E+02	-.3901E+00	-.2647E+06	-.7222E+06	.7512E+03
.1705E+02	-.4499E+03	.2147E+02	-.2500E+05	.2142E+04	-.2635E+02	-.4094E+00	-.2693E+06	-.7166E+06	.7548E+03
.1715E+02	-.4721E+03	.2139E+02	-.2500E+05	.2247E+04	-.2765E+02	-.4273E+00	-.2727E+06	-.7241E+06	.7584E+03
.1725E+02	-.4930E+03	.2132E+02	-.2500E+05	.2347E+04	-.2887E+02	-.4438E+00	-.2760E+06	-.7315E+06	.7620E+03
.1735E+02	-.5125E+03	.2124E+02	-.2500E+05	.2440E+04	-.3001E+02	-.4590E+00	-.2792E+06	-.7385E+06	.7656E+03
.1745E+02	-.5307E+03	.2116E+02	-.2500E+05	.2526E+04	-.3108E+02	-.4731E+00	-.2823E+06	-.7453E+06	.7692E+03
.1755E+02	-.5482E+03	.2109E+02	-.2500E+05	.2610E+04	-.3211E+02	-.4864E+00	-.2838E+06	-.7488E+06	.7728E+03
.1765E+02	-.5661E+03	.2101E+02	-.2500E+05	.2695E+04	-.3316E+02	-.4997E+00	-.2828E+06	-.7467E+06	.7763E+03
.1775E+02	-.5843E+03	.2094E+02	-.2500E+05	.2782E+04	-.3422E+02	-.5130E+00	-.2820E+06	-.7450E+06	.7798E+03
.1785E+02	-.6028E+03	.2086E+02	-.2500E+05	.2869E+04	-.3530E+02	-.5261E+00	-.2813E+06	-.7437E+06	.7834E+03
.1795E+02	-.6213E+03	.2079E+02	-.2500E+05	.2957E+04	-.3639E+02	-.5391E+00	-.2807E+06	-.7429E+06	.7869E+03
.1805E+02	-.6400E+03	.2071E+02	-.2500E+05	.3046E+04	-.3748E+02	-.5518E+00	-.2804E+06	-.7423E+06	.7904E+03
.1815E+02	-.6591E+03	.2064E+02	-.2500E+05	.3137E+04	-.3860E+02	-.5645E+00	-.2809E+06	-.7397E+06	.7939E+03
.1825E+02	-.6786E+03	.2056E+02	-.2500E+05	.3230E+04	-.3974E+02	-.5771E+00	-.2816E+06	-.7375E+06	.7974E+03
.1835E+02	-.6980E+03	.2049E+02	-.2500E+05	.3323E+04	-.4088E+02	-.5894E+00	-.2825E+06	-.7357E+06	.8008E+03
.1845E+02	-.7181E+03	.2041E+02	-.2500E+05	.3418E+04	-.4205E+02	-.6017E+00	-.2835E+06	-.7344E+06	.8043E+03
.1855E+02	-.7384E+03	.2034E+02	-.2500E+05	.3515E+04	-.4325E+02	-.6138E+00	-.2840E+06	-.7327E+06	.8077E+03
.1865E+02	-.7593E+03	.2026E+02	-.2500E+05	.3614E+04	-.4447E+02	-.6258E+00	-.2826E+06	-.7296E+06	.8111E+03
.1875E+02	-.7807E+03	.2019E+02	-.2500E+05	.3716E+04	-.4572E+02	-.6378E+00	-.2815E+06	-.7269E+06	.8146E+03
.1885E+02	-.8025E+03	.2012E+02	-.2500E+05	.3820E+04	-.4700E+02	-.6495E+00	-.2805E+06	-.7246E+06	.8180E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.1895E+02	-.8246E+03	.2004E+02	-.2500E+05	.3925E+04	-.4829E+02	-.6610E+00	-.2797E+06	-.7228E+06	.8213E+03
.1905E+02	-.8471E+03	.1997E+02	-.2500E+05	.4032E+04	-.4961E+02	-.6723E+00	-.2788E+06	-.7206E+06	.8247E+03
.1915E+02	-.8699E+03	.1990E+02	-.2500E+05	.4141E+04	-.5094E+02	-.6834E+00	-.2781E+06	-.7189E+06	.8281E+03
.1925E+02	-.8929E+03	.1983E+02	-.2500E+05	.4250E+04	-.5229E+02	-.6942E+00	-.2776E+06	-.7175E+06	.8314E+03
.1935E+02	-.9161E+03	.1975E+02	-.2500E+05	.4361E+04	-.5365E+02	-.7046E+00	-.2772E+06	-.7165E+06	.8348E+03
.1945E+02	-.9394E+03	.1968E+02	-.2500E+05	.4472E+04	-.5502E+02	-.7148E+00	-.2766E+06	-.7154E+06	.8381E+03
.1955E+02	-.9629E+03	.1961E+02	-.2500E+05	.4584E+04	-.5639E+02	-.7246E+00	-.2761E+06	-.7148E+06	.8414E+03
.1965E+02	-.9864E+03	.1954E+02	-.2500E+05	.4695E+04	-.5777E+02	-.7341E+00	-.2757E+06	-.7144E+06	.8447E+03
.1975E+02	-.1010E+04	.1947E+02	-.2500E+05	.4808E+04	-.5915E+02	-.7432E+00	-.2753E+06	-.7140E+06	.8480E+03
.1985E+02	-.1034E+04	.1940E+02	-.2500E+05	.4921E+04	-.6054E+02	-.7521E+00	-.2747E+06	-.7130E+06	.8513E+03
.1995E+02	-.1058E+04	.1933E+02	-.2500E+05	.5034E+04	-.6194E+02	-.7606E+00	-.2742E+06	-.7123E+06	.8546E+03
.2005E+02	-.1081E+04	.1926E+02	-.2500E+05	.5148E+04	-.6334E+02	-.7689E+00	-.2738E+06	-.7120E+06	.8578E+03
.2015E+02	-.1105E+04	.1919E+02	-.2500E+05	.5262E+04	-.6474E+02	-.7768E+00	-.2736E+06	-.7117E+06	.8611E+03
.2025E+02	-.1129E+04	.1912E+02	-.2500E+05	.5375E+04	-.6614E+02	-.7844E+00	-.2734E+06	-.7116E+06	.8643E+03
.2035E+02	-.1153E+04	.1905E+02	-.2500E+05	.5489E+04	-.6753E+02	-.7918E+00	-.2733E+06	-.7118E+06	.8675E+03
.2045E+02	-.1177E+04	.1898E+02	-.2500E+05	.5602E+04	-.6892E+02	-.7988E+00	-.2733E+06	-.7124E+06	.8707E+03
.2055E+02	-.1200E+04	.1891E+02	-.2500E+05	.5714E+04	-.7030E+02	-.8055E+00	-.2733E+06	-.7136E+06	.8739E+03
.2065E+02	-.1224E+04	.1884E+02	-.2500E+05	.5824E+04	-.7166E+02	-.8118E+00	-.2734E+06	-.7150E+06	.8771E+03
.2075E+02	-.1246E+04	.1877E+02	-.2500E+05	.5933E+04	-.7300E+02	-.8179E+00	-.2735E+06	-.7165E+06	.8803E+03
.2085E+02	-.1269E+04	.1870E+02	-.2500E+05	.6040E+04	-.7431E+02	-.8237E+00	-.2737E+06	-.7187E+06	.8835E+03
.2095E+02	-.1291E+04	.1864E+02	-.2500E+05	.6144E+04	-.7560E+02	-.8291E+00	-.2738E+06	-.7212E+06	.8866E+03
.2105E+02	-.1312E+04	.1857E+02	-.2500E+05	.6247E+04	-.7685E+02	-.8343E+00	-.2740E+06	-.7238E+06	.8897E+03
.2115E+02	-.1333E+04	.1850E+02	-.2500E+05	.6347E+04	-.7809E+02	-.8392E+00	-.2741E+06	-.7261E+06	.8929E+03
.2125E+02	-.1354E+04	.1843E+02	-.2500E+05	.6447E+04	-.7932E+02	-.8440E+00	-.2733E+06	-.7260E+05	.8960E+03
.2135E+02	-.1375E+04	.1836E+02	-.2500E+05	.6547E+04	-.8055E+02	-.8486E+00	-.2724E+06	-.7261E+06	.8991E+03
.2145E+02	-.1396E+04	.1829E+02	-.2500E+05	.6646E+04	-.8176E+02	-.8530E+00	-.2720E+06	-.7272E+06	.9022E+03
.2155E+02	-.1416E+04	.1823E+02	-.2500E+05	.6740E+04	-.8292E+02	-.8570E+00	-.2733E+06	-.7323E+06	.9053E+03
.2165E+02	-.1435E+04	.1816E+02	-.2500E+05	.6829E+04	-.8402E+02	-.8609E+00	-.2745E+06	-.7373E+06	.9083E+03
.2175E+02	-.1453E+04	.1809E+02	-.2500E+05	.6915E+04	-.8508E+02	-.8644E+00	-.2756E+06	-.7420E+06	.9114E+03
.2185E+02	-.1470E+04	.1802E+02	-.2500E+05	.6996E+04	-.8608E+02	-.8678E+00	-.2767E+06	-.7464E+06	.9144E+03
.2195E+02	-.1486E+04	.1796E+02	-.2500E+05	.7075E+04	-.8704E+02	-.8709E+00	-.2774E+06	-.7496E+06	.9175E+03
.2205E+02	-.1502E+04	.1789E+02	-.2500E+05	.7151E+04	-.8798E+02	-.8740E+00	-.2779E+06	-.7517E+06	.9205E+03
.2215E+02	-.1518E+04	.1782E+02	-.2500E+05	.7226E+04	-.8890E+02	-.8769E+00	-.2783E+06	-.7537E+06	.9235E+03
.2225E+02	-.1533E+04	.1775E+02	-.2500E+05	.7299E+04	-.8980E+02	-.8797E+00	-.2788E+06	-.7556E+06	.9265E+03
.2235E+02	-.1548E+04	.1768E+02	-.2500E+05	.7370E+04	-.9068E+02	-.8823E+00	-.2791E+06	-.7576E+06	.9295E+03
.2245E+02	-.1563E+04	.1762E+02	-.2500E+05	.7440E+04	-.9153E+02	-.8849E+00	-.2792E+06	-.7595E+06	.9325E+03
.2255E+02	-.1577E+04	.1755E+02	-.2500E+05	.7507E+04	-.9237E+02	-.8873E+00	-.2793E+06	-.7613E+06	.9355E+03
.2265E+02	-.1591E+04	.1748E+02	-.2500E+05	.7573E+04	-.9318E+02	-.8897E+00	-.2793E+06	-.7631E+06	.9384E+03
.2275E+02	-.1605E+04	.1741E+02	-.2500E+05	.7638E+04	-.9397E+02	-.8920E+00	-.2794E+06	-.7649E+06	.9414E+03
.2285E+02	-.1618E+04	.1735E+02	-.2500E+05	.7701E+04	-.9475E+02	-.8942E+00	-.2794E+06	-.7660E+06	.9443E+03
.2295E+02	-.1631E+04	.1728E+02	-.2500E+05	.7764E+04	-.9552E+02	-.8963E+00	-.2795E+06	-.7668E+06	.9472E+03
.2305E+02	-.1644E+04	.1721E+02	-.2500E+05	.7826E+04	-.9628E+02	-.8984E+00	-.2796E+06	-.7677E+06	.9501E+03
.2315E+02	-.1657E+04	.1715E+02	-.2500E+05	.7887E+04	-.9703E+02	-.9004E+00	-.2797E+06	-.7685E+06	.9530E+03
.2325E+02	-.1670E+04	.1708E+02	-.2500E+05	.7947E+04	-.9778E+02	-.9023E+00	-.2798E+06	-.7694E+06	.9559E+03
.2335E+02	-.1682E+04	.1701E+02	-.2500E+05	.8007E+04	-.9851E+02	-.9042E+00	-.2798E+06	-.7699E+06	.9588E+03
.2345E+02	-.1695E+04	.1695E+02	-.2500E+05	.8066E+04	-.9924E+02	-.9060E+00	-.2798E+06	-.7705E+06	.9617E+03
.2355E+02	-.1707E+04	.1688E+02	-.2500E+05	.8125E+04	-.9996E+02	-.9078E+00	-.2799E+06	-.7711E+06	.9645E+03
.2365E+02	-.1719E+04	.1681E+02	-.2500E+05	.8183E+04	-.1007E+03	-.9096E+00	-.2799E+06	-.7718E+06	.9674E+03
.2375E+02	-.1731E+04	.1675E+02	-.2500E+05	.8240E+04	-.1014E+03	-.9113E+00	-.2800E+06	-.7725E+06	.9702E+03
.2385E+02	-.1743E+04	.1668E+02	-.2500E+05	.8296E+04	-.1021E+03	-.9129E+00	-.2803E+06	-.7733E+06	.9730E+03
.2395E+02	-.1755E+04	.1662E+02	-.2500E+05	.8352E+04	-.1028E+03	-.9145E+00	-.2805E+06	-.7741E+06	.9758E+03
.2405E+02	-.1766E+04	.1655E+02	-.2500E+05	.8407E+04	-.1034E+03	-.9161E+00	-.2807E+06	-.7749E+06	.9786E+03
.2415E+02	-.1777E+04	.1649E+02	-.2500E+05	.8461E+04	-.1041E+03	-.9176E+00	-.2809E+06	-.7757E+06	.9814E+03
.2425E+02	-.1789E+04	.1642E+02	-.2500E+05	.8514E+04	-.1048E+03	-.9191E+00	-.2808E+06	-.7761E+06	.9842E+03
.2435E+02	-.1800E+04	.1635E+02	-.2500E+05	.8568E+04	-.1054E+03	-.9206E+00	-.2805E+06	-.7762E+06	.9869E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TDENG=	PWRENG=	XMPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.2445E+02	-.1811E+04	.1629E+02	-.2500E+05	.8621E+04	-.1061E+03	-.9220E+00	-.2803E+06	-.7765E+06	.9897E+03
.2455E+02	-.1822E+04	.1622E+02	-.2500E+05	.8674E+04	-.1067E+03	-.9234E+00	-.2800E+06	-.7767E+06	.9924E+03
.2465E+02	-.1833E+04	.1616E+02	-.2500E+05	.8727E+04	-.1074E+03	-.9247E+00	-.2798E+06	-.7770E+06	.9952E+03
.2475E+02	-.1844E+04	.1609E+02	-.2500E+05	.8779E+04	-.1080E+03	-.9261E+00	-.2797E+06	-.7774E+06	.9979E+03
.2485E+02	-.1855E+04	.1603E+02	-.2500E+05	.8830E+04	-.1086E+03	-.9274E+00	-.2798E+06	-.7780E+06	.1001E+04
.2495E+02	-.1866E+04	.1596E+02	-.2500E+05	.8881E+04	-.1093E+03	-.9286E+00	-.2799E+06	-.7785E+06	.1003E+04
.2505E+02	-.1876E+04	.1590E+02	-.2500E+05	.8932E+04	-.1099E+03	-.9298E+00	-.2800E+06	-.7791E+06	.1006E+04
.2515E+02	-.1887E+04	.1583E+02	-.2500E+05	.8982E+04	-.1105E+03	-.9311E+00	-.2802E+06	-.7796E+06	.1009E+04
.2525E+02	-.1897E+04	.1577E+02	-.2500E+05	.9031E+04	-.1111E+03	-.9322E+00	-.2803E+06	-.7802E+06	.1011E+04
.2535E+02	-.1908E+04	.1571E+02	-.2500E+05	.9080E+04	-.1117E+03	-.9334E+00	-.2802E+06	-.7805E+06	.1014E+04
.2545E+02	-.1918E+04	.1564E+02	-.2500E+05	.9129E+04	-.1123E+03	-.9345E+00	-.2799E+06	-.7805E+06	.1017E+04
.2555E+02	-.1928E+04	.1558E+02	-.2500E+05	.9178E+04	-.1129E+03	-.9356E+00	-.2797E+06	-.7805E+06	.1019E+04
.2565E+02	-.1938E+04	.1551E+02	-.2500E+05	.9226E+04	-.1135E+03	-.9367E+00	-.2795E+06	-.7806E+06	.1022E+04
.2575E+02	-.1948E+04	.1545E+02	-.2500E+05	.9275E+04	-.1141E+03	-.9378E+00	-.2793E+06	-.7808E+06	.1025E+04
.2585E+02	-.1959E+04	.1539E+02	-.2500E+05	.9323E+04	-.1147E+03	-.9388E+00	-.2791E+06	-.7809E+06	.1027E+04
.2595E+02	-.1969E+04	.1532E+02	-.2500E+05	.9371E+04	-.1153E+03	-.9398E+00	-.2789E+06	-.7812E+06	.1030E+04
.2605E+02	-.1979E+04	.1526E+02	-.2500E+05	.9418E+04	-.1159E+03	-.9408E+00	-.2787E+06	-.7822E+06	.1032E+04
.2615E+02	-.1988E+04	.1520E+02	-.2500E+05	.9464E+04	-.1164E+03	-.9418E+00	-.2786E+06	-.7831E+06	.1035E+04
.2625E+02	-.1998E+04	.1513E+02	-.2500E+05	.9509E+04	-.1170E+03	-.9427E+00	-.2784E+06	-.7840E+06	.1037E+04
.2635E+02	-.2007E+04	.1507E+02	-.2500E+05	.9554E+04	-.1175E+03	-.9437E+00	-.2782E+06	-.7849E+06	.1040E+04
.2645E+02	-.2016E+04	.1501E+02	-.2500E+05	.9597E+04	-.1181E+03	-.9446E+00	-.2780E+06	-.7858E+06	.1043E+04
.2655E+02	-.2025E+04	.1494E+02	-.2500E+05	.9640E+04	-.1186E+03	-.9454E+00	-.2779E+06	-.7866E+06	.1045E+04
.2665E+02	-.2034E+04	.1488E+02	-.2500E+05	.9682E+04	-.1191E+03	-.9463E+00	-.2777E+06	-.7874E+06	.1048E+04
.2675E+02	-.2043E+04	.1482E+02	-.2500E+05	.9723E+04	-.1196E+03	-.9471E+00	-.2772E+06	-.7878E+06	.1050E+04
.2685E+02	-.2051E+04	.1476E+02	-.2500E+05	.9764E+04	-.1201E+03	-.9479E+00	-.2766E+06	-.7880E+06	.1053E+04
.2695E+02	-.2060E+04	.1470E+02	-.2500E+05	.9805E+04	-.1206E+03	-.9487E+00	-.2761E+06	-.7882E+06	.1055E+04
.2705E+02	-.2068E+04	.1463E+02	-.2500E+05	.9846E+04	-.1211E+03	-.9495E+00	-.2755E+06	-.7884E+06	.1058E+04
.2715E+02	-.2077E+04	.1457E+02	-.2500E+05	.9887E+04	-.1216E+03	-.9503E+00	-.2750E+06	-.7886E+06	.1060E+04
.2725E+02	-.2085E+04	.1451E+02	-.2500E+05	.9927E+04	-.1221E+03	-.9510E+00	-.2745E+06	-.7889E+06	.1062E+04
.2735E+02	-.2094E+04	.1445E+02	-.2500E+05	.9967E+04	-.1226E+03	-.9518E+00	-.2739E+06	-.7892E+06	.1065E+04
.2745E+02	-.2102E+04	.1439E+02	-.2500E+05	.1001E+05	-.1231E+03	-.9525E+00	-.2734E+06	-.7895E+06	.1067E+04
.2755E+02	-.2110E+04	.1433E+02	-.2500E+05	.1005E+05	-.1236E+03	-.9532E+00	-.2729E+06	-.7899E+06	.1070E+04
.2765E+02	-.2118E+04	.1427E+02	-.2500E+05	.1008E+05	-.1241E+03	-.9539E+00	-.2724E+06	-.7903E+06	.1072E+04
.2775E+02	-.2126E+04	.1421E+02	-.2500E+05	.1012E+05	-.1245E+03	-.9546E+00	-.2719E+06	-.7908E+06	.1075E+04
.2785E+02	-.2134E+04	.1415E+02	-.2500E+05	.1016E+05	-.1250E+03	-.9553E+00	-.2714E+06	-.7912E+06	.1077E+04
.2795E+02	-.2142E+04	.1409E+02	-.2500E+05	.1020E+05	-.1255E+03	-.9559E+00	-.2709E+05	-.7917E+06	.1079E+04
.2805E+02	-.2150E+04	.1403E+02	-.2500E+05	.1023E+05	-.1259E+03	-.9566E+00	-.2704E+06	-.7921E+06	.1082E+04
.2815E+02	-.2158E+04	.1397E+02	-.2500E+05	.1027E+05	-.1264E+03	-.9572E+00	-.2699E+06	-.7926E+06	.1084E+04
.2825E+02	-.2165E+04	.1391E+02	-.2500E+05	.1031E+05	-.1268E+03	-.9578E+00	-.2694E+06	-.7930E+06	.1086E+04
.2835E+02	-.2173E+04	.1385E+02	-.2500E+05	.1034E+05	-.1272E+03	-.9584E+00	-.2690E+06	-.7934E+06	.1089E+04
.2845E+02	-.2180E+04	.1379E+02	-.2500E+05	.1038E+05	-.1277E+03	-.9590E+00	-.2685E+06	-.7938E+06	.1091E+04
.2855E+02	-.2187E+04	.1373E+02	-.2500E+05	.1041E+05	-.1281E+03	-.9596E+00	-.2682E+06	-.7940E+06	.1093E+04
.2865E+02	-.2194E+04	.1367E+02	-.2500E+05	.1045E+05	-.1285E+03	-.9602E+00	-.2678E+06	-.7942E+06	.1096E+04
.2875E+02	-.2202E+04	.1361E+02	-.2500E+05	.1048E+05	-.1289E+03	-.9607E+00	-.2675E+06	-.7944E+06	.1098E+04
.2885E+02	-.2209E+04	.1355E+02	-.2500E+05	.1051E+05	-.1294E+03	-.9613E+00	-.2672E+06	-.7946E+06	.1100E+04
.2895E+02	-.2216E+04	.1350E+02	-.2500E+05	.1055E+05	-.1298E+03	-.9619E+00	-.2669E+06	-.7949E+06	.1103E+04
.2905E+02	-.2223E+04	.1344E+02	-.2500E+05	.1058E+05	-.1302E+03	-.9624E+00	-.2666E+06	-.7951E+06	.1105E+04
.2915E+02	-.2230E+04	.1338E+02	-.2500E+05	.1061E+05	-.1306E+03	-.9629E+00	-.2663E+06	-.7953E+06	.1107E+04
.2925E+02	-.2237E+04	.1332E+02	-.2500E+05	.1065E+05	-.1310E+03	-.9634E+00	-.2660E+06	-.7955E+06	.1109E+04
.2935E+02	-.2244E+04	.1326E+02	-.2500E+05	.1068E+05	-.1314E+03	-.9639E+00	-.2657E+06	-.7958E+06	.1112E+04
.2945E+02	-.2250E+04	.1321E+02	-.2500E+05	.1071E+05	-.1318E+03	-.9644E+00	-.2654E+06	-.7960E+06	.1114E+04
.2955E+02	-.2257E+04	.1315E+02	-.2500E+05	.1074E+05	-.1322E+03	-.9649E+00	-.2652E+06	-.7964E+06	.1116E+04
.2965E+02	-.2264E+04	.1309E+02	-.2500E+05	.1078E+05	-.1326E+03	-.9654E+00	-.2652E+06	-.7971E+06	.1118E+04
.2975E+02	-.2270E+04	.1303E+02	-.2500E+05	.1081E+05	-.1330E+03	-.9659E+00	-.2651E+06	-.7978E+06	.1121E+04
.2985E+02	-.2277E+04	.1298E+02	-.2500E+05	.1084E+05	-.1333E+03	-.9664E+00	-.2650E+06	-.7984E+06	.1123E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.2995E+02	-.2283E+04	.1292E+02	-.2500E+05	.1087E+05	-.1337E+03	-.9668E+00	-.2649E+06	-.7990E+06	.1125E+04
.3005E+02	-.2289E+04	.1286E+02	-.2500E+05	.1089E+05	-.1340E+03	-.9673E+00	-.2648E+06	-.7996E+06	.1127E+04
.3015E+02	-.2295E+04	.1280E+02	-.2500E+05	.1092E+05	-.1344E+03	-.9677E+00	-.2647E+06	-.8001E+06	.1129E+04
.3025E+02	-.2301E+04	.1275E+02	-.2500E+05	.1095E+05	-.1347E+03	-.9681E+00	-.2646E+06	-.8006E+06	.1131E+04
.3035E+02	-.2306E+04	.1269E+02	-.2500E+05	.1098E+05	-.1351E+03	-.9685E+00	-.2645E+06	-.8011E+06	.1134E+04
.3045E+02	-.2312E+04	.1263E+02	-.2500E+05	.1101E+05	-.1354E+03	-.9690E+00	-.2644E+06	-.8015E+06	.1136E+04
.3055E+02	-.2318E+04	.1258E+02	-.2500E+05	.1103E+05	-.1357E+03	-.9694E+00	-.2643E+06	-.8019E+06	.1138E+04
.3065E+02	-.2323E+04	.1252E+02	-.2500E+05	.1106E+05	-.1361E+03	-.9698E+00	-.2641E+06	-.8024E+06	.1140E+04
.3075E+02	-.2328E+04	.1246E+02	-.2500E+05	.1108E+05	-.1364E+03	-.9701E+00	-.2640E+06	-.8030E+06	.1142E+04
.3085E+02	-.2333E+04	.1241E+02	-.2500E+05	.1111E+05	-.1366E+03	-.9705E+00	-.2642E+06	-.8056E+06	.1144E+04
.3095E+02	-.2338E+04	.1235E+02	-.2500E+05	.1113E+05	-.1369E+03	-.9709E+00	-.2644E+06	-.8080E+06	.1146E+04
.3105E+02	-.2342E+04	.1229E+02	-.2500E+05	.1115E+05	-.1371E+03	-.9712E+00	-.2644E+06	-.8100E+06	.1148E+04
.3115E+02	-.2345E+04	.1224E+02	-.2500E+05	.1116E+05	-.1374E+03	-.9716E+00	-.2644E+06	-.8119E+06	.1150E+04
.3125E+02	-.2349E+04	.1218E+02	-.2500E+05	.1118E+05	-.1375E+03	-.9719E+00	-.2644E+06	-.8136E+06	.1152E+04
.3135E+02	-.2352E+04	.1213E+02	-.2500E+05	.1119E+05	-.1377E+03	-.9722E+00	-.2643E+06	-.8150E+06	.1154E+04
.3145E+02	-.2354E+04	.1207E+02	-.2500E+05	.1121E+05	-.1379E+03	-.9725E+00	-.2642E+06	-.8164E+06	.1157E+04
.3155E+02	-.2357E+04	.1201E+02	-.2500E+05	.1122E+05	-.1380E+03	-.9728E+00	-.2640E+06	-.8175E+06	.1159E+04
.3165E+02	-.2359E+04	.1196E+02	-.2500E+05	.1123E+05	-.1382E+03	-.9731E+00	-.2638E+06	-.8186E+06	.1161E+04
.3175E+02	-.2362E+04	.1190E+02	-.2500E+05	.1124E+05	-.1383E+03	-.9734E+00	-.2636E+06	-.8195E+06	.1163E+04
.3185E+02	-.2364E+04	.1185E+02	-.2500E+05	.1125E+05	-.1384E+03	-.9737E+00	-.2634E+06	-.8204E+06	.1165E+04
.3195E+02	-.2365E+04	.1179E+02	-.2500E+05	.1126E+05	-.1385E+03	-.9740E+00	-.2631E+06	-.8211E+06	.1167E+04
.3205E+02	-.2367E+04	.1174E+02	-.2500E+05	.1127E+05	-.1386E+03	-.9742E+00	-.2629E+06	-.8218E+06	.1169E+04
.3215E+02	-.2369E+04	.1168E+02	-.2500E+05	.1128E+05	-.1387E+03	-.9745E+00	-.2626E+06	-.8224E+06	.1171E+04
.3225E+02	-.2370E+04	.1163E+02	-.2500E+05	.1128E+05	-.1388E+03	-.9748E+00	-.2623E+06	-.8229E+06	.1173E+04
.3235E+02	-.2372E+04	.1157E+02	-.2500E+05	.1129E+05	-.1389E+03	-.9750E+00	-.2620E+06	-.8234E+06	.1174E+04
.3245E+02	-.2373E+04	.1152E+02	-.2500E+05	.1130E+05	-.1390E+03	-.9753E+00	-.2620E+06	-.8249E+06	.1176E+04
.3255E+02	-.2374E+04	.1146E+02	-.2500E+05	.1130E+05	-.1390E+03	-.9755E+00	-.2623E+06	-.8267E+06	.1178E+04
.3265E+02	-.2374E+04	.1141E+02	-.2500E+05	.1130E+05	-.1390E+03	-.9757E+00	-.2624E+06	-.8283E+06	.1180E+04
.3275E+02	-.2374E+04	.1135E+02	-.2500E+05	.1130E+05	-.1391E+03	-.9760E+00	-.2625E+06	-.8297E+06	.1182E+04
.3285E+02	-.2374E+04	.1130E+02	-.2500E+05	.1130E+05	-.1391E+03	-.9762E+00	-.2625E+06	-.8309E+06	.1184E+04
.3295E+02	-.2374E+04	.1124E+02	-.2500E+05	.1130E+05	-.1391E+03	-.9764E+00	-.2625E+06	-.8319E+06	.1186E+04
.3305E+02	-.2374E+04	.1119E+02	-.2500E+05	.1130E+05	-.1390E+03	-.9766E+00	-.2625E+06	-.8328E+06	.1188E+04
.3315E+02	-.2373E+04	.1113E+02	-.2500E+05	.1130E+05	-.1390E+03	-.9768E+00	-.2624E+06	-.8336E+06	.1190E+04
.3325E+02	-.2373E+04	.1108E+02	-.2500E+05	.1130E+05	-.1390E+03	-.9770E+00	-.2623E+06	-.8342E+06	.1192E+04
.3335E+02	-.2372E+04	.1102E+02	-.2500E+05	.1129E+05	-.1389E+03	-.9773E+00	-.2622E+06	-.8348E+06	.1194E+04
.3345E+02	-.2371E+04	.1097E+02	-.2500E+05	.1129E+05	-.1389E+03	-.9775E+00	-.2621E+06	-.8353E+06	.1195E+04
.3355E+02	-.2370E+04	.1091E+02	-.2500E+05	.1128E+05	-.1388E+03	-.9777E+00	-.2619E+06	-.8357E+06	.1197E+04
.3365E+02	-.2370E+04	.1086E+02	-.2500E+05	.1128E+05	-.1388E+03	-.9779E+00	-.2617E+06	-.8361E+06	.1199E+04
.3375E+02	-.2369E+04	.1081E+02	-.2500E+05	.1127E+05	-.1387E+03	-.9780E+00	-.2615E+06	-.8364E+06	.1201E+04
.3385E+02	-.2368E+04	.1075E+02	-.2500E+05	.1127E+05	-.1387E+03	-.9782E+00	-.2613E+06	-.8366E+06	.1203E+04
.3395E+02	-.2366E+04	.1070E+02	-.2500E+05	.1126E+05	-.1386E+03	-.9784E+00	-.2611E+06	-.8368E+06	.1205E+04
.3405E+02	-.2365E+04	.1065E+02	-.2500E+05	.1126E+05	-.1385E+03	-.9786E+00	-.2609E+06	-.8370E+06	.1206E+04
.3415E+02	-.2364E+04	.1059E+02	-.2500E+05	.1125E+05	-.1385E+03	-.9788E+00	-.2607E+06	-.8372E+06	.1208E+04
.3425E+02	-.2363E+04	.1054E+02	-.2500E+05	.1125E+05	-.1384E+03	-.9790E+00	-.2605E+06	-.8373E+06	.1210E+04
.3435E+02	-.2362E+04	.1048E+02	-.2500E+05	.1124E+05	-.1383E+03	-.9792E+00	-.2602E+06	-.8374E+06	.1212E+04
.3445E+02	-.2361E+04	.1043E+02	-.2500E+05	.1124E+05	-.1382E+03	-.9794E+00	-.2600E+06	-.8375E+06	.1213E+04
.3455E+02	-.2359E+04	.1038E+02	-.2500E+05	.1123E+05	-.1382E+03	-.9795E+00	-.2598E+06	-.8376E+06	.1215E+04
.3465E+02	-.2358E+04	.1032E+02	-.2500E+05	.1122E+05	-.1381E+03	-.9797E+00	-.2596E+06	-.8379E+06	.1217E+04
.3475E+02	-.2357E+04	.1027E+02	-.2500E+05	.1122E+05	-.1380E+03	-.9799E+00	-.2597E+06	-.8393E+06	.1219E+04
.3485E+02	-.2355E+04	.1022E+02	-.2500E+05	.1121E+05	-.1379E+03	-.9801E+00	-.2598E+06	-.8405E+06	.1220E+04
.3495E+02	-.2353E+04	.1017E+02	-.2500E+05	.1120E+05	-.1378E+03	-.9802E+00	-.2598E+06	-.8415E+06	.1222E+04
.3505E+02	-.2351E+04	.1011E+02	-.2500E+05	.1119E+05	-.1377E+03	-.9804E+00	-.2597E+06	-.8423E+06	.1224E+04
.3515E+02	-.2349E+04	.1006E+02	-.2500E+05	.1118E+05	-.1375E+03	-.9806E+00	-.2596E+06	-.8430E+06	.1226E+04
.3525E+02	-.2346E+04	.1001E+02	-.2500E+05	.1117E+05	-.1374E+03	-.9807E+00	-.2595E+06	-.8436E+06	.1227E+04
.3535E+02	-.2344E+04	.9954E+01	-.2500E+05	.1116E+05	-.1373E+03	-.9809E+00	-.2594E+06	-.8441E+06	.1229E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	YNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.3545E+02	-.2341E+04	.9902E+01	-.2500E+05	.1115E+05	-.1371E+03	-.9811E+00	-.2593E+06	-.8445E+06	.1231E+04
.3555E+02	-.2339E+04	.9849E+01	-.2500E+05	.1113E+05	-.1370E+03	-.9812E+00	-.2591E+06	-.8448E+06	.1232E+04
.3565E+02	-.2336E+04	.9797E+01	-.2500E+05	.1112E+05	-.1368E+03	-.9814E+00	-.2589E+06	-.8451E+06	.1234E+04
.3575E+02	-.2334E+04	.9744E+01	-.2500E+05	.1111E+05	-.1367E+03	-.9815E+00	-.2587E+06	-.8453E+06	.1236E+04
.3585E+02	-.2331E+04	.9692E+01	-.2500E+05	.1110E+05	-.1365E+03	-.9817E+00	-.2585E+06	-.8455E+06	.1237E+04
.3595E+02	-.2328E+04	.9640E+01	-.2500E+05	.1108E+05	-.1364E+03	-.9818E+00	-.2583E+06	-.8457E+06	.1239E+04
.3505E+02	-.2326E+04	.9588E+01	-.2500E+05	.1107E+05	-.1362E+03	-.9820E+00	-.2581E+06	-.8458E+06	.1240E+04
.3615E+02	-.2323E+04	.9536E+01	-.2500E+05	.1106E+05	-.1360E+03	-.9821E+00	-.2578E+06	-.8459E+06	.1242E+04
.3625E+02	-.2320E+04	.9484E+01	-.2500E+05	.1105E+05	-.1359E+03	-.9823E+00	-.2576E+06	-.8459E+06	.1244E+04
.3635E+02	-.2318E+04	.9432E+01	-.2500E+05	.1103E+05	-.1357E+03	-.9824E+00	-.2574E+06	-.8460E+06	.1245E+04
.3645E+02	-.2315E+04	.9380E+01	-.2500E+05	.1102E+05	-.1356E+03	-.9826E+00	-.2571E+06	-.8460E+06	.1247E+04
.3655E+02	-.2312E+04	.9329E+01	-.2500E+05	.1101E+05	-.1354E+03	-.9827E+00	-.2569E+06	-.8460E+06	.1248E+04
.3665E+02	-.2310E+04	.9277E+01	-.2500E+05	.1099E+05	-.1353E+03	-.9829E+00	-.2566E+06	-.8460E+06	.1250E+04
.3675E+02	-.2307E+04	.9226E+01	-.2500E+05	.1098E+05	-.1351E+03	-.9830E+00	-.2564E+06	-.8460E+06	.1252E+04
.3685E+02	-.2304E+04	.9175E+01	-.2500E+05	.1097E+05	-.1349E+03	-.9831E+00	-.2561E+06	-.8460E+06	.1253E+04
.3595E+02	-.2302E+04	.9123E+01	-.2500E+05	.1096E+05	-.1348E+03	-.9833E+00	-.2559E+06	-.8460E+06	.1255E+04
.3705E+02	-.2299E+04	.9072E+01	-.2500E+05	.1094E+05	-.1346E+03	-.9834E+00	-.2557E+06	-.8459E+06	.1256E+04
.3715E+02	-.2296E+04	.9021E+01	-.2500E+05	.1093E+05	-.1345E+03	-.9836E+00	-.2554E+06	-.8459E+06	.1258E+04
.3725E+02	-.2294E+04	.8970E+01	-.2500E+05	.1092E+05	-.1343E+03	-.9837E+00	-.2552E+06	-.8459E+06	.1259E+04
.3735E+02	-.2291E+04	.8919E+01	-.2500E+05	.1091E+05	-.1342E+03	-.9839E+00	-.2549E+06	-.8458E+06	.1261E+04
.3745E+02	-.2288E+04	.8868E+01	-.2500E+05	.1089E+05	-.1340E+03	-.9840E+00	-.2551E+06	-.8466E+05	.1262E+04
.3755E+02	-.2285E+04	.8818E+01	-.2500E+05	.1088E+05	-.1338E+03	-.9842E+00	-.2552E+06	-.8473E+06	.1264E+04
.3765E+02	-.2283E+04	.8767E+01	-.2500E+05	.1087E+05	-.1337E+03	-.9843E+00	-.2553E+06	-.8480E+05	.1265E+04
.3775E+02	-.2279E+04	.8716E+01	-.2500E+05	.1085E+05	-.1335E+03	-.9844E+00	-.2554E+06	-.8485E+06	.1267E+04
.3785E+02	-.2276E+04	.8665E+01	-.2500E+05	.1084E+05	-.1333E+03	-.9846E+00	-.2554E+06	-.8489E+06	.1268E+04
.3795E+02	-.2273E+04	.8614E+01	-.2500E+05	.1082E+05	-.1331E+03	-.9847E+00	-.2554E+06	-.8492E+06	.1270E+04
.3805E+02	-.2270E+04	.8564E+01	-.2500E+05	.1080E+05	-.1329E+03	-.9848E+00	-.2554E+06	-.8494E+06	.1271E+04
.3815E+02	-.2267E+04	.8513E+01	-.2500E+05	.1079E+05	-.1327E+03	-.9850E+00	-.2554E+06	-.8496E+06	.1273E+04
.3825E+02	-.2263E+04	.8463E+01	-.2500E+05	.1077E+05	-.1325E+03	-.9851E+00	-.2554E+06	-.8498E+06	.1274E+04
.3835E+02	-.2260E+04	.8412E+01	-.2500E+05	.1076E+05	-.1324E+03	-.9852E+00	-.2554E+06	-.8499E+06	.1275E+04
.3845E+02	-.2257E+04	.8362E+01	-.2500E+05	.1074E+05	-.1322E+03	-.9854E+00	-.2553E+06	-.8500E+06	.1277E+04
.3855E+02	-.2253E+04	.8311E+01	-.2500E+05	.1073E+05	-.1320E+03	-.9855E+00	-.2553E+06	-.8500E+06	.1278E+04
.3865E+02	-.2250E+04	.8261E+01	-.2500E+05	.1071E+05	-.1318E+03	-.9856E+00	-.2552E+06	-.8501E+06	.1280E+04
.3875E+02	-.2247E+04	.8211E+01	-.2500E+05	.1069E+05	-.1316E+03	-.9857E+00	-.2552E+06	-.8501E+06	.1281E+04
.3885E+02	-.2243E+04	.8160E+01	-.2500E+05	.1068E+05	-.1314E+03	-.9859E+00	-.2551E+06	-.8501E+06	.1282E+04
.3895E+02	-.2240E+04	.8110E+01	-.2500E+05	.1066E+05	-.1312E+03	-.9860E+00	-.2550E+06	-.8501E+06	.1284E+04
.3905E+02	-.2237E+04	.8060E+01	-.2500E+05	.1065E+05	-.1310E+03	-.9861E+00	-.2550E+06	-.8501E+06	.1285E+04
.3915E+02	-.2233E+04	.8010E+01	-.2500E+05	.1063E+05	-.1308E+03	-.9863E+00	-.2549E+06	-.8501E+06	.1286E+04
.3925E+02	-.2230E+04	.7960E+01	-.2500E+05	.1061E+05	-.1306E+03	-.9864E+00	-.2548E+06	-.8500E+06	.1288E+04
.3935E+02	-.2227E+04	.7910E+01	-.2500E+05	.1060E+05	-.1304E+03	-.9865E+00	-.2547E+06	-.8500E+06	.1289E+04
.3945E+02	-.2223E+04	.7860E+01	-.2500E+05	.1058E+05	-.1302E+03	-.9866E+00	-.2547E+06	-.8500E+06	.1291E+04
.3955E+02	-.2220E+04	.7810E+01	-.2500E+05	.1057E+05	-.1300E+03	-.9868E+00	-.2546E+06	-.8499E+06	.1292E+04
.3965E+02	-.2217E+04	.7760E+01	-.2500E+05	.1055E+05	-.1298E+03	-.9869E+00	-.2545E+06	-.8499E+06	.1293E+04
.3975E+02	-.2214E+04	.7710E+01	-.2500E+05	.1054E+05	-.1296E+03	-.9870E+00	-.2544E+06	-.8498E+06	.1294E+04
.3985E+02	-.2210E+04	.7661E+01	-.2500E+05	.1052E+05	-.1295E+03	-.9872E+00	-.2544E+06	-.8498E+06	.1296E+04
.3995E+02	-.2207E+04	.7611E+01	-.2500E+05	.1051E+05	-.1293E+03	-.9873E+00	-.2543E+06	-.8497E+06	.1297E+04
.4005E+02	-.2204E+04	.7561E+01	-.2500E+05	.1049E+05	-.1291E+03	-.9874E+00	-.2542E+06	-.8496E+06	.1298E+04
.4015E+02	-.2201E+04	.7512E+01	-.2500E+05	.1048E+05	-.1289E+03	-.9875E+00	-.2542E+06	-.8497E+06	.1300E+04
.4025E+02	-.2198E+04	.7462E+01	-.2500E+05	.1046E+05	-.1287E+03	-.9877E+00	-.2545E+06	-.8502E+06	.1301E+04
.4035E+02	-.2195E+04	.7412E+01	-.2500E+05	.1045E+05	-.1285E+03	-.9878E+00	-.2547E+06	-.8506E+06	.1302E+04
.4045E+02	-.2191E+04	.7363E+01	-.2500E+05	.1043E+05	-.1283E+03	-.9879E+00	-.2550E+06	-.8510E+06	.1303E+04
.4055E+02	-.2188E+04	.7313E+01	-.2500E+05	.1042E+05	-.1282E+03	-.9880E+00	-.2552E+06	-.8514E+06	.1305E+04
.4065E+02	-.2185E+04	.7263E+01	-.2500E+05	.1040E+05	-.1280E+03	-.9882E+00	-.2553E+06	-.8514E+06	.1306E+04
.4075E+02	-.2181E+04	.7214E+01	-.2500E+05	.1038E+05	-.1277E+03	-.9883E+00	-.2555E+06	-.8515E+06	.1307E+04
.4085E+02	-.2178E+04	.7164E+01	-.2500E+05	.1037E+05	-.1275E+03	-.9884E+00	-.2556E+06	-.8515E+06	.1308E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.4095E+02	-.2174E+04	.7114E+01	-.2500E+05	.1035E+05	-.1273E+03	-.9885E+00	-.2557E+06	-.8515E+06	.1309E+04
.4105E+02	-.2171E+04	.7065E+01	-.2500E+05	.1033E+05	-.1271E+03	-.9886E+00	-.2558E+06	-.8515E+06	.1311E+04
.4115E+02	-.2167E+04	.7015E+01	-.2500E+05	.1032E+05	-.1269E+03	-.9888E+00	-.2559E+06	-.8515E+06	.1312E+04
.4125E+02	-.2164E+04	.6965E+01	-.2500E+05	.1030E+05	-.1267E+03	-.9889E+00	-.2560E+06	-.8514E+06	.1313E+04
.4135E+02	-.2161E+04	.6916E+01	-.2500E+05	.1028E+05	-.1265E+03	-.9890E+00	-.2562E+06	-.8514E+06	.1314E+04
.4145E+02	-.2157E+04	.6866E+01	-.2500E+05	.1027E+05	-.1263E+03	-.9891E+00	-.2562E+06	-.8513E+06	.1315E+04
.4155E+02	-.2154E+04	.6817E+01	-.2500E+05	.1025E+05	-.1261E+03	-.9893E+00	-.2563E+06	-.8513E+06	.1317E+04
.4165E+02	-.2150E+04	.6767E+01	-.2500E+05	.1024E+05	-.1259E+03	-.9894E+00	-.2564E+06	-.8512E+06	.1318E+04
.4175E+02	-.2147E+04	.6717E+01	-.2500E+05	.1022E+05	-.1257E+03	-.9895E+00	-.2565E+06	-.8512E+06	.1319E+04
.4185E+02	-.2144E+04	.6668E+01	-.2500E+05	.1020E+05	-.1255E+03	-.9896E+00	-.2566E+06	-.8511E+06	.1320E+04
.4195E+02	-.2140E+04	.6618E+01	-.2500E+05	.1019E+05	-.1253E+03	-.9897E+00	-.2567E+06	-.8510E+06	.1321E+04
.4205E+02	-.2137E+04	.6569E+01	-.2500E+05	.1017E+05	-.1251E+03	-.9899E+00	-.2568E+06	-.8510E+06	.1322E+04
.4215E+02	-.2134E+04	.6519E+01	-.2500E+05	.1016E+05	-.1250E+03	-.9900E+00	-.2569E+06	-.8509E+06	.1323E+04
.4225E+02	-.2130E+04	.6470E+01	-.2500E+05	.1014E+05	-.1248E+03	-.9901E+00	-.2570E+06	-.8508E+06	.1324E+04
.4235E+02	-.2127E+04	.6420E+01	-.2500E+05	.1013E+05	-.1246E+03	-.9902E+00	-.2570E+06	-.8507E+06	.1325E+04
.4245E+02	-.2124E+04	.6371E+01	-.2500E+05	.1011E+05	-.1244E+03	-.9903E+00	-.2571E+06	-.8507E+06	.1327E+04
.4255E+02	-.2121E+04	.6321E+01	-.2500E+05	.1009E+05	-.1242E+03	-.9904E+00	-.2572E+06	-.8506E+06	.1328E+04
.4265E+02	-.2117E+04	.6272E+01	-.2500E+05	.1008E+05	-.1240E+03	-.9906E+00	-.2573E+06	-.8505E+06	.1329E+04
.4275E+02	-.2114E+04	.6222E+01	-.2500E+05	.1006E+05	-.1238E+03	-.9907E+00	-.2574E+06	-.8504E+06	.1330E+04
.4285E+02	-.2111E+04	.6173E+01	-.2500E+05	.1005E+05	-.1236E+03	-.9908E+00	-.2575E+06	-.8504E+06	.1331E+04
.4295E+02	-.2108E+04	.6123E+01	-.2500E+05	.1003E+05	-.1234E+03	-.9909E+00	-.2578E+06	-.8504E+06	.1332E+04
.4305E+02	-.2105E+04	.6074E+01	-.2500E+05	.1002E+05	-.1233E+03	-.9910E+00	-.2581E+06	-.8503E+06	.1333E+04
.4315E+02	-.2102E+04	.6024E+01	-.2500E+05	.1000E+05	-.1231E+03	-.9912E+00	-.2585E+06	-.8503E+06	.1334E+04
.4325E+02	-.2099E+04	.5975E+01	-.2500E+05	.9989E+04	-.1229E+03	-.9913E+00	-.2588E+06	-.8503E+06	.1335E+04
.4335E+02	-.2095E+04	.5925E+01	-.2500E+05	.9974E+04	-.1227E+03	-.9914E+00	-.2591E+06	-.8503E+06	.1336E+04
.4345E+02	-.2092E+04	.5875E+01	-.2500E+05	.9960E+04	-.1225E+03	-.9915E+00	-.2594E+06	-.8502E+06	.1337E+04
.4355E+02	-.2089E+04	.5826E+01	-.2500E+05	.9945E+04	-.1224E+03	-.9916E+00	-.2597E+06	-.8501E+06	.1338E+04
.4365E+02	-.2086E+04	.5776E+01	-.2500E+05	.9930E+04	-.1222E+03	-.9917E+00	-.2601E+06	-.8501E+06	.1339E+04
.4375E+02	-.2083E+04	.5726E+01	-.2500E+05	.9916E+04	-.1220E+03	-.9919E+00	-.2604E+06	-.8500E+06	.1340E+04
.4385E+02	-.2080E+04	.5677E+01	-.2500E+05	.9902E+04	-.1218E+03	-.9920E+00	-.2607E+06	-.8500E+06	.1341E+04
.4395E+02	-.2077E+04	.5627E+01	-.2500E+05	.9887E+04	-.1216E+03	-.9921E+00	-.2609E+06	-.8499E+06	.1342E+04
.4405E+02	-.2074E+04	.5577E+01	-.2500E+05	.9873E+04	-.1215E+03	-.9922E+00	-.2612E+06	-.8498E+06	.1343E+04
.4415E+02	-.2071E+04	.5527E+01	-.2500E+05	.9859E+04	-.1213E+03	-.9923E+00	-.2615E+06	-.8497E+06	.1344E+04
.4425E+02	-.2068E+04	.5477E+01	-.2500E+05	.9845E+04	-.1211E+03	-.9924E+00	-.2618E+06	-.8497E+06	.1345E+04
.4435E+02	-.2065E+04	.5427E+01	-.2500E+05	.9831E+04	-.1210E+03	-.9926E+00	-.2621E+06	-.8496E+06	.1345E+04
.4445E+02	-.2062E+04	.5377E+01	-.2500E+05	.9817E+04	-.1208E+03	-.9927E+00	-.2624E+06	-.8495E+06	.1346E+04
.4455E+02	-.2059E+04	.5327E+01	-.2500E+05	.9803E+04	-.1206E+03	-.9928E+00	-.2627E+06	-.8494E+06	.1347E+04
.4465E+02	-.2057E+04	.5277E+01	-.2500E+05	.9789E+04	-.1204E+03	-.9929E+00	-.2629E+06	-.8494E+06	.1348E+04
.4475E+02	-.2054E+04	.5227E+01	-.2500E+05	.9776E+04	-.1203E+03	-.9930E+00	-.2632E+06	-.8493E+06	.1349E+04
.4485E+02	-.2051E+04	.5177E+01	-.2500E+05	.9762E+04	-.1201E+03	-.9931E+00	-.2635E+06	-.8492E+06	.1350E+04
.4495E+02	-.2048E+04	.5127E+01	-.2500E+05	.9749E+04	-.1199E+03	-.9932E+00	-.2637E+06	-.8491E+06	.1351E+04
.4505E+02	-.2045E+04	.5077E+01	-.2500E+05	.9735E+04	-.1198E+03	-.9933E+00	-.2640E+06	-.8490E+06	.1352E+04
.4515E+02	-.2042E+04	.5027E+01	-.2500E+05	.9722E+04	-.1196E+03	-.9935E+00	-.2643E+06	-.8489E+06	.1353E+04
.4525E+02	-.2040E+04	.4977E+01	-.2500E+05	.9709E+04	-.1195E+03	-.9936E+00	-.2645E+06	-.8489E+06	.1353E+04
.4535E+02	-.2037E+04	.4927E+01	-.2500E+05	.9696E+04	-.1193E+03	-.9937E+00	-.2647E+06	-.8483E+06	.1354E+04
.4545E+02	-.2034E+04	.4876E+01	-.2500E+05	.9683E+04	-.1191E+03	-.9938E+00	-.2648E+06	-.8476E+06	.1355E+04
.4555E+02	-.2032E+04	.4826E+01	-.2500E+05	.9671E+04	-.1190E+03	-.9939E+00	-.2650E+06	-.8472E+06	.1356E+04
.4565E+02	-.2029E+04	.4776E+01	-.2500E+05	.9660E+04	-.1188E+03	-.9940E+00	-.2651E+06	-.8468E+06	.1357E+04
.4575E+02	-.2027E+04	.4726E+01	-.2500E+05	.9648E+04	-.1187E+03	-.9941E+00	-.2653E+06	-.8463E+06	.1357E+04
.4585E+02	-.2025E+04	.4676E+01	-.2500E+05	.9638E+04	-.1186E+03	-.9942E+00	-.2656E+06	-.8460E+06	.1358E+04
.4595E+02	-.2023E+04	.4625E+01	-.2500E+05	.9627E+04	-.1184E+03	-.9943E+00	-.2658E+06	-.8457E+06	.1359E+04
.4605E+02	-.2020E+04	.4575E+01	-.2500E+05	.9617E+04	-.1183E+03	-.9945E+00	-.2660E+06	-.8455E+06	.1360E+04
.4615E+02	-.2018E+04	.4525E+01	-.2500E+05	.9607E+04	-.1182E+03	-.9946E+00	-.2663E+06	-.8453E+06	.1361E+04
.4625E+02	-.2016E+04	.4474E+01	-.2500E+05	.9598E+04	-.1181E+03	-.9947E+00	-.2665E+06	-.8452E+06	.1361E+04
.4635E+02	-.2014E+04	.4424E+01	-.2500E+05	.9588E+04	-.1180E+03	-.9948E+00	-.2668E+06	-.8450E+06	.1362E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.4645E+02	-.2012E+04	.4374E+01	-.2500E+05	.9579E+04	-.1179E+03	-.9949E+00	-.2670E+06	-.8448E+06	.1363E+04
.4655E+02	-.2010E+04	.4323E+01	-.2500E+05	.9570E+04	-.1177E+03	-.9950E+00	-.2673E+06	-.8447E+06	.1364E+04
.4665E+02	-.2009E+04	.4273E+01	-.2500E+05	.9561E+04	-.1176E+03	-.9951E+00	-.2675E+06	-.8446E+06	.1364E+04
.4675E+02	-.2007E+04	.4222E+01	-.2500E+05	.9552E+04	-.1175E+03	-.9952E+00	-.2678E+06	-.8444E+06	.1365E+04
.4685E+02	-.2005E+04	.4172E+01	-.2500E+05	.9543E+04	-.1174E+03	-.9953E+00	-.2681E+06	-.8443E+06	.1366E+04
.4695E+02	-.2003E+04	.4121E+01	-.2500E+05	.9534E+04	-.1173E+03	-.9954E+00	-.2683E+06	-.8442E+06	.1366E+04
.4705E+02	-.2001E+04	.4071E+01	-.2500E+05	.9526E+04	-.1172E+03	-.9955E+00	-.2686E+06	-.8441E+06	.1367E+04
.4715E+02	-.1999E+04	.4020E+01	-.2500E+05	.9517E+04	-.1171E+03	-.9956E+00	-.2688E+06	-.8440E+06	.1368E+04
.4725E+02	-.1998E+04	.3969E+01	-.2500E+05	.9509E+04	-.1170E+03	-.9957E+00	-.2690E+06	-.8439E+06	.1368E+04
.4735E+02	-.1996E+04	.3919E+01	-.2500E+05	.9500E+04	-.1169E+03	-.9958E+00	-.2693E+06	-.8438E+06	.1369E+04
.4745E+02	-.1994E+04	.3868E+01	-.2500E+05	.9492E+04	-.1168E+03	-.9959E+00	-.2694E+06	-.8436E+06	.1370E+04
.4755E+02	-.1993E+04	.3817E+01	-.2500E+05	.9485E+04	-.1167E+03	-.9960E+00	-.2693E+06	-.8428E+06	.1370E+04
.4765E+02	-.1991E+04	.3767E+01	-.2500E+05	.9478E+04	-.1166E+03	-.9961E+00	-.2692E+06	-.8421E+06	.1371E+04
.4775E+02	-.1990E+04	.3716E+01	-.2500E+05	.9472E+04	-.1165E+03	-.9962E+00	-.2691E+06	-.8416E+06	.1372E+04
.4785E+02	-.1989E+04	.3666E+01	-.2500E+05	.9466E+04	-.1165E+03	-.9963E+00	-.2690E+06	-.8410E+06	.1372E+04
.4795E+02	-.1988E+04	.3615E+01	-.2500E+05	.9461E+04	-.1164E+03	-.9964E+00	-.2690E+06	-.8406E+06	.1373E+04
.4805E+02	-.1986E+04	.3565E+01	-.2500E+05	.9455E+04	-.1163E+03	-.9965E+00	-.2690E+06	-.8401E+06	.1374E+04
.4815E+02	-.1985E+04	.3514E+01	-.2500E+05	.9451E+04	-.1163E+03	-.9966E+00	-.2690E+06	-.8398E+06	.1374E+04
.4825E+02	-.1984E+04	.3464E+01	-.2500E+05	.9446E+04	-.1162E+03	-.9967E+00	-.2690E+06	-.8395E+06	.1375E+04
.4835E+02	-.1984E+04	.3413E+01	-.2500E+05	.9442E+04	-.1162E+03	-.9968E+00	-.2690E+06	-.8392E+06	.1375E+04
.4845E+02	-.1983E+04	.3363E+01	-.2500E+05	.9438E+04	-.1161E+03	-.9969E+00	-.2690E+06	-.8390E+06	.1376E+04
.4855E+02	-.1982E+04	.3312E+01	-.2500E+05	.9434E+04	-.1161E+03	-.9970E+00	-.2690E+06	-.8388E+06	.1376E+04
.4865E+02	-.1981E+04	.3262E+01	-.2500E+05	.9430E+04	-.1160E+03	-.9971E+00	-.2691E+06	-.8386E+06	.1377E+04
.4875E+02	-.1980E+04	.3211E+01	-.2500E+05	.9426E+04	-.1160E+03	-.9971E+00	-.2691E+06	-.8384E+06	.1378E+04
.4885E+02	-.1980E+04	.3161E+01	-.2500E+05	.9423E+04	-.1159E+03	-.9972E+00	-.2691E+06	-.8383E+06	.1378E+04
.4895E+02	-.1979E+04	.3110E+01	-.2500E+05	.9420E+04	-.1159E+03	-.9973E+00	-.2692E+06	-.8382E+06	.1379E+04
.4905E+02	-.1978E+04	.3060E+01	-.2500E+05	.9417E+04	-.1159E+03	-.9974E+00	-.2692E+06	-.8380E+06	.1379E+04
.4915E+02	-.1978E+04	.3010E+01	-.2500E+05	.9414E+04	-.1158E+03	-.9975E+00	-.2693E+06	-.8379E+06	.1380E+04
.4925E+02	-.1977E+04	.2959E+01	-.2500E+05	.9411E+04	-.1158E+03	-.9976E+00	-.2693E+06	-.8378E+06	.1380E+04
.4935E+02	-.1976E+04	.2909E+01	-.2500E+05	.9407E+04	-.1157E+03	-.9976E+00	-.2694E+06	-.8376E+06	.1381E+04
.4945E+02	-.1976E+04	.2858E+01	-.2500E+05	.9405E+04	-.1157E+03	-.9977E+00	-.2694E+06	-.8375E+06	.1381E+04
.4955E+02	-.1975E+04	.2808E+01	-.2500E+05	.9403E+04	-.1157E+03	-.9978E+00	-.2693E+06	-.8370E+06	.1382E+04
.4965E+02	-.1975E+04	.2758E+01	-.2500E+05	.9401E+04	-.1157E+03	-.9979E+00	-.2692E+06	-.8365E+06	.1382E+04
.4975E+02	-.1975E+04	.2707E+01	-.2500E+05	.9400E+04	-.1157E+03	-.9980E+00	-.2691E+06	-.8361E+06	.1383E+04
.4985E+02	-.1974E+04	.2657E+01	-.2500E+05	.9399E+04	-.1156E+03	-.9980E+00	-.2690E+06	-.8357E+06	.1383E+04
.4995E+02	-.1974E+04	.2607E+01	-.2500E+05	.9398E+04	-.1156E+03	-.9981E+00	-.2690E+06	-.8355E+06	.1383E+04
.5005E+02	-.1974E+04	.2556E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9982E+00	-.2689E+06	-.8352E+06	.1384E+04
.5015E+02	-.1974E+04	.2506E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9982E+00	-.2689E+06	-.8350E+06	.1384E+04
.5025E+02	-.1974E+04	.2456E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9983E+00	-.2689E+06	-.8349E+06	.1385E+04
.5035E+02	-.1974E+04	.2406E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9984E+00	-.2689E+06	-.8347E+06	.1385E+04
.5045E+02	-.1974E+04	.2356E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9985E+00	-.2689E+06	-.8346E+06	.1386E+04
.5055E+02	-.1974E+04	.2305E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9985E+00	-.2689E+06	-.8345E+06	.1386E+04
.5065E+02	-.1974E+04	.2255E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9986E+00	-.2689E+06	-.8344E+06	.1386E+04
.5075E+02	-.1974E+04	.2205E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9986E+00	-.2689E+06	-.8343E+06	.1387E+04
.5085E+02	-.1974E+04	.2155E+01	-.2500E+05	.9397E+04	-.1156E+03	-.9987E+00	-.2689E+06	-.8342E+06	.1387E+04
.5095E+02	-.1974E+04	.2105E+01	-.2500E+05	.9398E+04	-.1156E+03	-.9988E+00	-.2689E+06	-.8342E+06	.1387E+04
.5105E+02	-.1974E+04	.2054E+01	-.2500E+05	.9399E+04	-.1156E+03	-.9988E+00	-.2690E+06	-.8342E+06	.1388E+04
.5115E+02	-.1975E+04	.2004E+01	-.2500E+05	.9399E+04	-.1156E+03	-.9989E+00	-.2690E+06	-.8342E+06	.1388E+04
.5125E+02	-.1975E+04	.1954E+01	-.2500E+05	.9400E+04	-.1156E+03	-.9989E+00	-.2690E+06	-.8341E+06	.1388E+04
.5135E+02	-.1975E+04	.1904E+01	-.2500E+05	.9400E+04	-.1157E+03	-.9990E+00	-.2690E+06	-.8341E+06	.1389E+04
.5145E+02	-.1975E+04	.1854E+01	-.2500E+05	.9402E+04	-.1157E+03	-.9990E+00	-.2689E+06	-.8330E+05	.1389E+04
.5155E+02	-.1976E+04	.1804E+01	-.2500E+05	.9404E+04	-.1157E+03	-.9991E+00	-.2688E+06	-.8318E+06	.1389E+04
.5165E+02	-.1976E+04	.1754E+01	-.2500E+05	.9407E+04	-.1157E+03	-.9991E+00	-.2687E+06	-.8306E+06	.1390E+04
.5175E+02	-.1977E+04	.1704E+01	-.2500E+05	.9411E+04	-.1158E+03	-.9992E+00	-.2687E+06	-.8298E+06	.1390E+04
.5185E+02	-.1978E+04	.1654E+01	-.2500E+05	.9416E+04	-.1158E+03	-.9992E+00	-.2687E+06	-.8290E+06	.1390E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.5195E+02	-.1979E+04	.1604E+01	-.2500E+05	.9420E+04	-.1159E+03	-.9993E+00	-.2687E+06	-.8283E+06	.1391E+04
.5205E+02	-.1980E+04	.1553E+01	-.2500E+05	.9426E+04	-.1160E+03	-.9993E+00	-.2688E+06	-.8279E+06	.1391E+04
.5215E+02	-.1982E+04	.1503E+01	-.2500E+05	.9432E+04	-.1161E+03	-.9994E+00	-.2689E+06	-.8275E+06	.1391E+04
.5225E+02	-.1983E+04	.1453E+01	-.2500E+05	.9439E+04	-.1161E+03	-.9994E+00	-.2690E+06	-.8273E+06	.1391E+04
.5235E+02	-.1984E+04	.1403E+01	-.2500E+05	.9446E+04	-.1162E+03	-.9995E+00	-.2692E+06	-.8271E+06	.1392E+04
.5245E+02	-.1986E+04	.1353E+01	-.2500E+05	.9452E+04	-.1163E+03	-.9995E+00	-.2694E+06	-.8270E+06	.1392E+04
.5255E+02	-.1987E+04	.1303E+01	-.2500E+05	.9459E+04	-.1164E+03	-.9995E+00	-.2696E+06	-.8270E+06	.1392E+04
.5265E+02	-.1989E+04	.1253E+01	-.2500E+05	.9466E+04	-.1165E+03	-.9996E+00	-.2698E+06	-.8270E+06	.1392E+04
.5275E+02	-.1990E+04	.1202E+01	-.2500E+05	.9473E+04	-.1165E+03	-.9996E+00	-.2700E+06	-.8270E+06	.1392E+04
.5285E+02	-.1991E+04	.1152E+01	-.2500E+05	.9480E+04	-.1166E+03	-.9996E+00	-.2702E+06	-.8271E+06	.1393E+04
.5295E+02	-.1993E+04	.1102E+01	-.2500E+05	.9486E+04	-.1167E+03	-.9997E+00	-.2704E+06	-.8272E+06	.1393E+04
.5305E+02	-.1994E+04	.1051E+01	-.2500E+05	.9493E+04	-.1168E+03	-.9997E+00	-.2706E+06	-.8273E+06	.1393E+04
.5315E+02	-.1996E+04	.1001E+01	-.2500E+05	.9500E+04	-.1169E+03	-.9997E+00	-.2703E+06	-.8269E+06	.1393E+04
.5325E+02	-.1997E+04	.9509E+00	-.2500E+05	.9507E+04	-.1170E+03	-.9998E+00	-.2701E+06	-.8265E+06	.1393E+04
.5335E+02	-.1999E+04	.9007E+00	-.2500E+05	.9514E+04	-.1171E+03	-.9998E+00	-.2699E+06	-.8262E+06	.1394E+04
.5345E+02	-.2000E+04	.8505E+00	-.2500E+05	.9522E+04	-.1172E+03	-.9998E+00	-.2697E+06	-.8260E+06	.1394E+04
.5355E+02	-.2002E+04	.8003E+00	-.2500E+05	.9530E+04	-.1172E+03	-.9998E+00	-.2696E+06	-.8260E+06	.1394E+04
.5365E+02	-.2004E+04	.7501E+00	-.2500E+05	.9537E+04	-.1173E+03	-.9998E+00	-.2695E+06	-.8260E+06	.1394E+04
.5375E+02	-.2005E+04	.6999E+00	-.2500E+05	.9545E+04	-.1174E+03	-.9999E+00	-.2695E+06	-.8261E+06	.1394E+04
.5385E+02	-.2007E+04	.6498E+00	-.2500E+05	.9553E+04	-.1175E+03	-.9999E+00	-.2695E+06	-.8263E+06	.1394E+04
.5395E+02	-.2008E+04	.5996E+00	-.2500E+05	.9560E+04	-.1176E+03	-.9999E+00	-.2695E+06	-.8266E+06	.1394E+04
.5405E+02	-.2010E+04	.5494E+00	-.2500E+05	.9568E+04	-.1177E+03	-.9999E+00	-.2695E+06	-.8269E+06	.1394E+04
.5415E+02	-.2012E+04	.4993E+00	-.2500E+05	.9576E+04	-.1178E+03	-.9999E+00	-.2696E+06	-.8274E+06	.1394E+04
.5425E+02	-.2013E+04	.4491E+00	-.2500E+05	.9582E+04	-.1179E+03	-.9999E+00	-.2696E+06	-.8276E+06	.1395E+04
.5435E+02	-.2014E+04	.3989E+00	-.2500E+05	.9588E+04	-.1180E+03	-.1000E+01	-.2697E+06	-.8280E+06	.1395E+04
.5445E+02	-.2015E+04	.3488E+00	-.2500E+05	.9594E+04	-.1180E+03	-.1000E+01	-.2698E+06	-.8284E+06	.1395E+04
.5455E+02	-.2017E+04	.2985E+00	-.2500E+05	.9599E+04	-.1181E+03	-.1000E+01	-.2699E+06	-.8287E+06	.1395E+04
.5465E+02	-.2018E+04	.2483E+00	-.2500E+05	.9604E+04	-.1182E+03	-.1000E+01	-.2700E+06	-.8292E+06	.1395E+04
.5475E+02	-.2019E+04	.1981E+00	-.2500E+05	.9608E+04	-.1182E+03	-.1000E+01	-.2701E+06	-.8295E+06	.1395E+04
.5485E+02	-.2019E+04	.1478E+00	-.2500E+05	.9613E+04	-.1183E+03	-.1000E+01	-.2702E+06	-.8300E+06	.1395E+04
.5495E+02	-.2020E+04	.9752E-01	-.2500E+05	.9616E+04	-.1183E+03	-.1000E+01	-.2703E+06	-.8304E+06	.1395E+04
.5505E+02	-.2021E+04	.4723E-01	-.2500E+05	.9620E+04	-.1184E+03	-.1000E+01	-.2705E+06	-.8309E+06	.1395E+04
.5515E+02	-.2021E+04	-.3109E-02	-.2500E+05	.9622E+04	-.1184E+03	-.1000E+01	-.2706E+06	-.8313E+06	.1395E+04
.5525E+02	-.2022E+04	-.5345E-01	-.2500E+05	.9625E+04	-.1184E+03	-.1000E+01	-.2707E+06	-.8317E+06	.1395E+04
.5535E+02	-.2023E+04	-.1038E+00	-.2500E+05	.9627E+04	-.1184E+03	-.1000E+01	-.2708E+06	-.8319E+06	.1395E+04
.5545E+02	-.2023E+04	-.1542E+00	-.2500E+05	.9630E+04	-.1185E+03	-.1000E+01	-.2709E+06	-.8320E+06	.1395E+04
.5555E+02	-.2023E+04	-.2046E+00	-.2500E+05	.9632E+04	-.1185E+03	-.1000E+01	-.2709E+06	-.8320E+06	.1395E+04
.5565E+02	-.2024E+04	-.2549E+00	-.2500E+05	.9634E+04	-.1185E+03	-.1000E+01	-.2709E+06	-.8318E+06	.1395E+04
.5575E+02	-.2024E+04	-.3053E+00	-.2500E+05	.9636E+04	-.1186E+03	-.1000E+01	-.2709E+06	-.8316E+06	.1395E+04
.5585E+02	-.2025E+04	-.3557E+00	-.2500E+05	.9638E+04	-.1186E+03	-.1000E+01	-.2708E+06	-.8312E+06	.1395E+04
.5595E+02	-.2025E+04	-.4060E+00	-.2500E+05	.9641E+04	-.1186E+03	-.1000E+01	-.2708E+06	-.8309E+06	.1395E+04
.5605E+02	-.2026E+04	-.4564E+00	-.2500E+05	.9644E+04	-.1187E+03	-.9999E+00	-.2707E+06	-.8304E+06	.1395E+04
.5615E+02	-.2027E+04	-.5067E+00	-.2500E+05	.9648E+04	-.1187E+03	-.9999E+00	-.2707E+06	-.8300E+06	.1394E+04
.5625E+02	-.2028E+04	-.5570E+00	-.2500E+05	.9652E+04	-.1188E+03	-.9999E+00	-.2706E+06	-.8294E+06	.1394E+04
.5635E+02	-.2029E+04	-.6073E+00	-.2500E+05	.9657E+04	-.1188E+03	-.9999E+00	-.2706E+06	-.8289E+06	.1394E+04
.5645E+02	-.2030E+04	-.6576E+00	-.2500E+05	.9662E+04	-.1189E+03	-.9999E+00	-.2705E+06	-.8283E+06	.1394E+04
.5655E+02	-.2031E+04	-.7079E+00	-.2500E+05	.9668E+04	-.1189E+03	-.9999E+00	-.2705E+06	-.8278E+06	.1394E+04
.5665E+02	-.2032E+04	-.7582E+00	-.2500E+05	.9674E+04	-.1190E+03	-.9998E+00	-.2704E+06	-.8271E+06	.1394E+04
.5675E+02	-.2034E+04	-.8084E+00	-.2500E+05	.9681E+04	-.1191E+03	-.9998E+00	-.2704E+06	-.8265E+06	.1394E+04
.5685E+02	-.2035E+04	-.8586E+00	-.2500E+05	.9687E+04	-.1192E+03	-.9998E+00	-.2703E+06	-.8258E+06	.1394E+04
.5695E+02	-.2037E+04	-.9088E+00	-.2500E+05	.9696E+04	-.1193E+03	-.9998E+00	-.2703E+06	-.8252E+06	.1393E+04
.5705E+02	-.2039E+04	-.9591E+00	-.2500E+05	.9704E+04	-.1194E+03	-.9998E+00	-.2703E+06	-.8245E+06	.1393E+04
.5715E+02	-.2040E+04	-.1009E+01	-.2500E+05	.9713E+04	-.1195E+03	-.9997E+00	-.2703E+06	-.8238E+06	.1393E+04
.5725E+02	-.2042E+04	-.1059E+01	-.2500E+05	.9722E+04	-.1196E+03	-.9997E+00	-.2702E+06	-.8231E+06	.1393E+04
.5735E+02	-.2044E+04	-.1110E+01	-.2500E+05	.9731E+04	-.1197E+03	-.9997E+00	-.2704E+06	-.8233E+06	.1393E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.5745E+02	-.2046E+04	-.1160E+01	-.2500E+05	.9741E+04	-.1198E+03	-.9996E+00	-.2705E+06	-.8237E+06	.1393E+04
.5755E+02	-.2048E+04	-.1210E+01	-.2500E+05	.9750E+04	-.1200E+03	-.9996E+00	-.2707E+06	-.8240E+06	.1392E+04
.5765E+02	-.2050E+04	-.1260E+01	-.2500E+05	.9759E+04	-.1201E+03	-.9996E+00	-.2708E+06	-.8243E+06	.1392E+04
.5775E+02	-.2052E+04	-.1311E+01	-.2500E+05	.9768E+04	-.1202E+03	-.9996E+00	-.2709E+06	-.8246E+06	.1392E+04
.5785E+02	-.2054E+04	-.1361E+01	-.2500E+05	.9777E+04	-.1203E+03	-.9995E+00	-.2709E+06	-.8248E+06	.1392E+04
.5795E+02	-.2056E+04	-.1411E+01	-.2500E+05	.9786E+04	-.1204E+03	-.9995E+00	-.2710E+06	-.8249E+06	.1392E+04
.5805E+02	-.2058E+04	-.1461E+01	-.2500E+05	.9794E+04	-.1205E+03	-.9995E+00	-.2710E+06	-.8249E+06	.1391E+04
.5815E+02	-.2059E+04	-.1512E+01	-.2500E+05	.9802E+04	-.1206E+03	-.9994E+00	-.2710E+06	-.8248E+06	.1391E+04
.5825E+02	-.2061E+04	-.1562E+01	-.2500E+05	.9811E+04	-.1207E+03	-.9994E+00	-.2710E+06	-.8246E+06	.1391E+04
.5835E+02	-.2063E+04	-.1612E+01	-.2500E+05	.9819E+04	-.1208E+03	-.9993E+00	-.2710E+06	-.8245E+06	.1391E+04
.5845E+02	-.2065E+04	-.1662E+01	-.2500E+05	.9828E+04	-.1209E+03	-.9993E+00	-.2709E+06	-.8243E+06	.1390E+04
.5855E+02	-.2066E+04	-.1712E+01	-.2500E+05	.9837E+04	-.1210E+03	-.9993E+00	-.2709E+06	-.8241E+06	.1390E+04
.5865E+02	-.2068E+04	-.1763E+01	-.2500E+05	.9846E+04	-.1211E+03	-.9992E+00	-.2708E+06	-.8238E+06	.1390E+04
.5875E+02	-.2070E+04	-.1813E+01	-.2500E+05	.9855E+04	-.1212E+03	-.9992E+00	-.2708E+06	-.8236E+06	.1389E+04
.5885E+02	-.2072E+04	-.1863E+01	-.2500E+05	.9864E+04	-.1214E+03	-.9991E+00	-.2707E+06	-.8233E+06	.1389E+04
.5895E+02	-.2074E+04	-.1913E+01	-.2500E+05	.9874E+04	-.1215E+03	-.9991E+00	-.2707E+06	-.8231E+06	.1389E+04
.5905E+02	-.2076E+04	-.1963E+01	-.2500E+05	.9883E+04	-.1216E+03	-.9990E+00	-.2706E+06	-.8228E+06	.1388E+04
.5915E+02	-.2078E+04	-.2013E+01	-.2500E+05	.9893E+04	-.1217E+03	-.9990E+00	-.2706E+06	-.8228E+06	.1388E+04
.5925E+02	-.2080E+04	-.2063E+01	-.2500E+05	.9903E+04	-.1218E+03	-.9989E+00	-.2708E+06	-.8233E+06	.1388E+04
.5935E+02	-.2082E+04	-.2113E+01	-.2500E+05	.9913E+04	-.1220E+03	-.9989E+00	-.2710E+06	-.8238E+06	.1387E+04
.5945E+02	-.2084E+04	-.2163E+01	-.2500E+05	.9922E+04	-.1221E+03	-.9988E+00	-.2711E+06	-.8243E+06	.1387E+04
.5955E+02	-.2086E+04	-.2214E+01	-.2500E+05	.9931E+04	-.1222E+03	-.9988E+00	-.2712E+06	-.8245E+06	.1387E+04
.5965E+02	-.2088E+04	-.2264E+01	-.2500E+05	.9939E+04	-.1223E+03	-.9987E+00	-.2712E+06	-.8246E+06	.1386E+04
.5975E+02	-.2090E+04	-.2314E+01	-.2500E+05	.9947E+04	-.1224E+03	-.9987E+00	-.2713E+06	-.8248E+06	.1386E+04
.5985E+02	-.2091E+04	-.2364E+01	-.2500E+05	.9956E+04	-.1225E+03	-.9986E+00	-.2713E+06	-.8249E+06	.1385E+04
.5995E+02	-.2093E+04	-.2414E+01	-.2500E+05	.9964E+04	-.1226E+03	-.9986E+00	-.2714E+06	-.8249E+06	.1385E+04
.6005E+02	-.2095E+04	-.2464E+01	-.2500E+05	.9972E+04	-.1227E+03	-.9985E+00	-.2714E+06	-.8250E+06	.1385E+04
.6015E+02	-.2097E+04	-.2514E+01	-.2500E+05	.9980E+04	-.1228E+03	-.9984E+00	-.2714E+06	-.8249E+06	.1384E+04
.6025E+02	-.2098E+04	-.2564E+01	-.2500E+05	.9988E+04	-.1229E+03	-.9984E+00	-.2713E+06	-.8249E+06	.1384E+04
.6035E+02	-.2100E+04	-.2614E+01	-.2500E+05	.9996E+04	-.1230E+03	-.9983E+00	-.2713E+06	-.8248E+06	.1383E+04
.6045E+02	-.2102E+04	-.2664E+01	-.2500E+05	.1000E+05	-.1231E+03	-.9983E+00	-.2713E+06	-.8246E+06	.1383E+04
.6055E+02	-.2103E+04	-.2714E+01	-.2500E+05	.1001E+05	-.1232E+03	-.9982E+00	-.2712E+06	-.8245E+06	.1382E+04
.6065E+02	-.2105E+04	-.2764E+01	-.2500E+05	.1002E+05	-.1233E+03	-.9981E+00	-.2712E+06	-.8244E+06	.1382E+04
.6075E+02	-.2107E+04	-.2814E+01	-.2500E+05	.1003E+05	-.1234E+03	-.9981E+00	-.2712E+06	-.8243E+06	.1382E+04
.6085E+02	-.2109E+04	-.2864E+01	-.2500E+05	.1004E+05	-.1235E+03	-.9980E+00	-.2711E+06	-.8241E+06	.1381E+04
.6095E+02	-.2110E+04	-.2914E+01	-.2500E+05	.1005E+05	-.1236E+03	-.9979E+00	-.2711E+06	-.8240E+06	.1381E+04
.6105E+02	-.2112E+04	-.2964E+01	-.2500E+05	.1005E+05	-.1237E+03	-.9979E+00	-.2710E+06	-.8238E+06	.1380E+04
.6115E+02	-.2114E+04	-.3014E+01	-.2500E+05	.1006E+05	-.1238E+03	-.9978E+00	-.2710E+06	-.8236E+06	.1380E+04
.6125E+02	-.2116E+04	-.3064E+01	-.2500E+05	.1007E+05	-.1239E+03	-.9977E+00	-.2709E+06	-.8235E+06	.1379E+04
.6135E+02	-.2118E+04	-.3113E+01	-.2500E+05	.1008E+05	-.1240E+03	-.9977E+00	-.2710E+06	-.8235E+06	.1379E+04
.6145E+02	-.2120E+04	-.3163E+01	-.2500E+05	.1009E+05	-.1241E+03	-.9976E+00	-.2710E+06	-.8237E+06	.1378E+04
.6155E+02	-.2122E+04	-.3213E+01	-.2500E+05	.1010E+05	-.1243E+03	-.9975E+00	-.2711E+06	-.8239E+06	.1377E+04
.6165E+02	-.2124E+04	-.3263E+01	-.2500E+05	.1011E+05	-.1244E+03	-.9974E+00	-.2711E+06	-.8240E+06	.1377E+04
.6175E+02	-.2125E+04	-.3313E+01	-.2500E+05	.1012E+05	-.1245E+03	-.9974E+00	-.2711E+06	-.8241E+06	.1376E+04
.6185E+02	-.2127E+04	-.3362E+01	-.2500E+05	.1012E+05	-.1246E+03	-.9973E+00	-.2711E+06	-.8241E+06	.1376E+04
.6195E+02	-.2129E+04	-.3412E+01	-.2500E+05	.1013E+05	-.1247E+03	-.9972E+00	-.2711E+06	-.8241E+06	.1375E+04
.6205E+02	-.2131E+04	-.3462E+01	-.2500E+05	.1014E+05	-.1248E+03	-.9971E+00	-.2710E+06	-.8240E+06	.1375E+04
.6215E+02	-.2132E+04	-.3511E+01	-.2500E+05	.1015E+05	-.1249E+03	-.9971E+00	-.2710E+06	-.8240E+06	.1374E+04
.6225E+02	-.2134E+04	-.3561E+01	-.2500E+05	.1016E+05	-.1250E+03	-.9970E+00	-.2710E+06	-.8239E+06	.1373E+04
.6235E+02	-.2136E+04	-.3611E+01	-.2500E+05	.1017E+05	-.1251E+03	-.9969E+00	-.2709E+06	-.8239E+06	.1373E+04
.6245E+02	-.2138E+04	-.3660E+01	-.2500E+05	.1018E+05	-.1252E+03	-.9968E+00	-.2709E+06	-.8238E+06	.1372E+04
.6255E+02	-.2139E+04	-.3710E+01	-.2500E+05	.1018E+05	-.1253E+03	-.9967E+00	-.2709E+06	-.8237E+06	.1372E+04
.6265E+02	-.2141E+04	-.3759E+01	-.2500E+05	.1019E+05	-.1254E+03	-.9967E+00	-.2708E+06	-.8236E+06	.1371E+04
.6275E+02	-.2143E+04	-.3809E+01	-.2500E+05	.1020E+05	-.1255E+03	-.9966E+00	-.2708E+06	-.8235E+06	.1370E+04
.6285E+02	-.2145E+04	-.3858E+01	-.2500E+05	.1021E+05	-.1256E+03	-.9965E+00	-.2707E+06	-.8234E+06	.1370E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.6295E+02	-.2147E+04	-.3908E+01	-.2500E+05	.1022E+05	-.1257E+03	-.9964E+00	-.2707E+06	-.8233E+06	.1369E+04
.6305E+02	-.2149E+04	-.3957E+01	-.2500E+05	.1023E+05	-.1258E+03	-.9963E+00	-.2706E+06	-.8232E+06	.1368E+04
.6315E+02	-.2151E+04	-.4007E+01	-.2500E+05	.1024E+05	-.1260E+03	-.9962E+00	-.2706E+06	-.8230E+06	.1368E+04
.6325E+02	-.2153E+04	-.4056E+01	-.2500E+05	.1025E+05	-.1261E+03	-.9962E+00	-.2705E+06	-.8229E+06	.1367E+04
.6335E+02	-.2155E+04	-.4105E+01	-.2500E+05	.1026E+05	-.1262E+03	-.9961E+00	-.2705E+06	-.8228E+06	.1366E+04
.6345E+02	-.2156E+04	-.4154E+01	-.2500E+05	.1027E+05	-.1263E+03	-.9960E+00	-.2704E+06	-.8227E+06	.1366E+04
.6355E+02	-.2158E+04	-.4204E+01	-.2500E+05	.1027E+05	-.1264E+03	-.9959E+00	-.2703E+06	-.8226E+06	.1365E+04
.6365E+02	-.2160E+04	-.4253E+01	-.2500E+05	.1028E+05	-.1265E+03	-.9958E+00	-.2704E+06	-.8227E+06	.1364E+04
.6375E+02	-.2162E+04	-.4302E+01	-.2500E+05	.1029E+05	-.1266E+03	-.9957E+00	-.2704E+06	-.8228E+06	.1364E+04
.6385E+02	-.2164E+04	-.4351E+01	-.2500E+05	.1030E+05	-.1268E+03	-.9956E+00	-.2704E+06	-.8229E+06	.1363E+04
.6395E+02	-.2166E+04	-.4400E+01	-.2500E+05	.1031E+05	-.1269E+03	-.9955E+00	-.2704E+06	-.8229E+06	.1362E+04
.6405E+02	-.2168E+04	-.4450E+01	-.2500E+05	.1032E+05	-.1270E+03	-.9954E+00	-.2704E+06	-.8229E+06	.1361E+04
.6415E+02	-.2170E+04	-.4499E+01	-.2500E+05	.1033E+05	-.1271E+03	-.9953E+00	-.2704E+06	-.8229E+06	.1361E+04
.6425E+02	-.2172E+04	-.4548E+01	-.2500E+05	.1034E+05	-.1272E+03	-.9953E+00	-.2703E+06	-.8229E+06	.1360E+04
.6435E+02	-.2174E+04	-.4597E+01	-.2500E+05	.1035E+05	-.1273E+03	-.9952E+00	-.2703E+06	-.8228E+06	.1359E+04
.6445E+02	-.2176E+04	-.4646E+01	-.2500E+05	.1036E+05	-.1274E+03	-.9951E+00	-.2703E+06	-.8228E+06	.1358E+04
.6455E+02	-.2178E+04	-.4695E+01	-.2500E+05	.1037E+05	-.1275E+03	-.9950E+00	-.2702E+06	-.8227E+06	.1357E+04
.6465E+02	-.2180E+04	-.4744E+01	-.2500E+05	.1038E+05	-.1277E+03	-.9949E+00	-.2702E+06	-.8227E+06	.1357E+04
.6475E+02	-.2182E+04	-.4793E+01	-.2500E+05	.1038E+05	-.1278E+03	-.9948E+00	-.2702E+06	-.8226E+06	.1356E+04
.6485E+02	-.2184E+04	-.4841E+01	-.2500E+05	.1039E+05	-.1279E+03	-.9947E+00	-.2701E+06	-.8225E+06	.1355E+04
.6495E+02	-.2186E+04	-.4890E+01	-.2500E+05	.1040E+05	-.1280E+03	-.9946E+00	-.2701E+06	-.8225E+06	.1354E+04
.6505E+02	-.2187E+04	-.4939E+01	-.2500E+05	.1041E+05	-.1281E+03	-.9945E+00	-.2700E+06	-.8224E+06	.1353E+04
.6515E+02	-.2189E+04	-.4988E+01	-.2500E+05	.1042E+05	-.1282E+03	-.9944E+00	-.2700E+06	-.8223E+06	.1353E+04
.6525E+02	-.2191E+04	-.5037E+01	-.2500E+05	.1043E+05	-.1283E+03	-.9943E+00	-.2699E+06	-.8222E+06	.1352E+04
.6535E+02	-.2193E+04	-.5085E+01	-.2500E+05	.1044E+05	-.1285E+03	-.9942E+00	-.2699E+06	-.8221E+06	.1351E+04
.6545E+02	-.2196E+04	-.5134E+01	-.2500E+05	.1045E+05	-.1286E+03	-.9941E+00	-.2698E+06	-.8220E+06	.1350E+04
.6555E+02	-.2198E+04	-.5182E+01	-.2500E+05	.1046E+05	-.1287E+03	-.9940E+00	-.2698E+06	-.8219E+06	.1349E+04
.6565E+02	-.2200E+04	-.5231E+01	-.2500E+05	.1047E+05	-.1288E+03	-.9939E+00	-.2697E+06	-.8218E+06	.1348E+04
.6575E+02	-.2202E+04	-.5280E+01	-.2500E+05	.1048E+05	-.1289E+03	-.9938E+00	-.2697E+06	-.8217E+06	.1347E+04
.6585E+02	-.2204E+04	-.5328E+01	-.2500E+05	.1049E+05	-.1291E+03	-.9937E+00	-.2696E+06	-.8216E+06	.1346E+04
.6595E+02	-.2206E+04	-.5377E+01	-.2500E+05	.1050E+05	-.1292E+03	-.9936E+00	-.2696E+06	-.8215E+06	.1346E+04
.6605E+02	-.2208E+04	-.5425E+01	-.2500E+05	.1051E+05	-.1293E+03	-.9935E+00	-.2696E+06	-.8217E+06	.1345E+04
.6615E+02	-.2210E+04	-.5473E+01	-.2500E+05	.1052E+05	-.1294E+03	-.9934E+00	-.2696E+06	-.8218E+06	.1344E+04
.6625E+02	-.2212E+04	-.5522E+01	-.2500E+05	.1053E+05	-.1296E+03	-.9933E+00	-.2696E+06	-.8219E+06	.1343E+04
.6635E+02	-.2214E+04	-.5570E+01	-.2500E+05	.1054E+05	-.1297E+03	-.9932E+00	-.2696E+06	-.8219E+06	.1342E+04
.6645E+02	-.2216E+04	-.5618E+01	-.2500E+05	.1055E+05	-.1298E+03	-.9931E+00	-.2696E+06	-.8220E+06	.1341E+04
.6655E+02	-.2218E+04	-.5667E+01	-.2500E+05	.1056E+05	-.1299E+03	-.9930E+00	-.2696E+06	-.8220E+06	.1340E+04
.6665E+02	-.2220E+04	-.5715E+01	-.2500E+05	.1057E+05	-.1300E+03	-.9929E+00	-.2696E+06	-.8220E+06	.1339E+04
.6675E+02	-.2222E+04	-.5763E+01	-.2500E+05	.1058E+05	-.1301E+03	-.9927E+00	-.2695E+06	-.8220E+06	.1338E+04
.6685E+02	-.2224E+04	-.5811E+01	-.2500E+05	.1059E+05	-.1303E+03	-.9926E+00	-.2695E+06	-.8220E+06	.1337E+04
.6695E+02	-.2226E+04	-.5860E+01	-.2500E+05	.1060E+05	-.1304E+03	-.9925E+00	-.2695E+06	-.8219E+06	.1336E+04
.6705E+02	-.2228E+04	-.5908E+01	-.2500E+05	.1061E+05	-.1305E+03	-.9924E+00	-.2694E+06	-.8219E+06	.1335E+04
.6715E+02	-.2230E+04	-.5956E+01	-.2500E+05	.1062E+05	-.1306E+03	-.9923E+00	-.2694E+06	-.8218E+06	.1334E+04
.6725E+02	-.2232E+04	-.6004E+01	-.2500E+05	.1062E+05	-.1307E+03	-.9922E+00	-.2693E+06	-.8218E+06	.1333E+04
.6735E+02	-.2234E+04	-.6052E+01	-.2500E+05	.1063E+05	-.1308E+03	-.9921E+00	-.2693E+06	-.8217E+06	.1332E+04
.6745E+02	-.2236E+04	-.6100E+01	-.2500E+05	.1064E+05	-.1310E+03	-.9920E+00	-.2692E+06	-.8217E+06	.1331E+04
.6755E+02	-.2238E+04	-.6147E+01	-.2500E+05	.1065E+05	-.1311E+03	-.9919E+00	-.2692E+06	-.8216E+06	.1330E+04
.6765E+02	-.2240E+04	-.6195E+01	-.2500E+05	.1066E+05	-.1312E+03	-.9918E+00	-.2691E+06	-.8215E+06	.1329E+04
.6775E+02	-.2242E+04	-.6243E+01	-.2500E+05	.1067E+05	-.1313E+03	-.9917E+00	-.2691E+06	-.8215E+06	.1328E+04
.6785E+02	-.2244E+04	-.6291E+01	-.2500E+05	.1068E+05	-.1314E+03	-.9915E+00	-.2690E+06	-.8214E+06	.1327E+04
.6795E+02	-.2246E+04	-.6339E+01	-.2500E+05	.1069E+05	-.1316E+03	-.9914E+00	-.2690E+06	-.8213E+06	.1326E+04
.6805E+02	-.2248E+04	-.6386E+01	-.2500E+05	.1070E+05	-.1317E+03	-.9913E+00	-.2689E+06	-.8212E+06	.1325E+04
.6815E+02	-.2250E+04	-.6434E+01	-.2500E+05	.1071E+05	-.1318E+03	-.9912E+00	-.2689E+06	-.8211E+06	.1324E+04
.6825E+02	-.2253E+04	-.6481E+01	-.2500E+05	.1072E+05	-.1319E+03	-.9911E+00	-.2688E+06	-.8211E+06	.1323E+04
.6835E+02	-.2255E+04	-.6529E+01	-.2500E+05	.1073E+05	-.1320E+03	-.9910E+00	-.2688E+06	-.8210E+06	.1321E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SMADVR=	THPROP=	TQPROP=	REACH=
.6845E+02	-.2257E+04	-.6577E+01	-.2500E+05	.1074E+05	-.1322E+03	-.9909E+00	-.2687E+06	-.8209E+06	.1320E+04
.6855E+02	-.2259E+04	-.6624E+01	-.2500E+05	.1075E+05	-.1323E+03	-.9908E+00	-.2687E+06	-.8209E+06	.1319E+04
.6865E+02	-.2261E+04	-.6671E+01	-.2500E+05	.1076E+05	-.1324E+03	-.9906E+00	-.2686E+06	-.8209E+06	.1318E+04
.6875E+02	-.2263E+04	-.6719E+01	-.2500E+05	.1077E+05	-.1325E+03	-.9905E+00	-.2686E+06	-.8209E+06	.1317E+04
.6885E+02	-.2265E+04	-.6766E+01	-.2500E+05	.1078E+05	-.1327E+03	-.9904E+00	-.2686E+06	-.8209E+06	.1316E+04
.6895E+02	-.2267E+04	-.6813E+01	-.2500E+05	.1079E+05	-.1328E+03	-.9903E+00	-.2685E+06	-.8209E+06	.1315E+04
.6905E+02	-.2269E+04	-.6861E+01	-.2500E+05	.1080E+05	-.1329E+03	-.9902E+00	-.2685E+06	-.8209E+06	.1314E+04
.6915E+02	-.2272E+04	-.6908E+01	-.2500E+05	.1081E+05	-.1330E+03	-.9901E+00	-.2685E+06	-.8209E+06	.1312E+04
.6925E+02	-.2274E+04	-.6955E+01	-.2500E+05	.1082E+05	-.1332E+03	-.9899E+00	-.2684E+06	-.8209E+06	.1311E+04
.6935E+02	-.2276E+04	-.7002E+01	-.2500E+05	.1083E+05	-.1333E+03	-.9898E+00	-.2684E+06	-.8208E+06	.1310E+04
.6945E+02	-.2278E+04	-.7049E+01	-.2500E+05	.1084E+05	-.1334E+03	-.9897E+00	-.2683E+06	-.8208E+06	.1309E+04
.6955E+02	-.2280E+04	-.7096E+01	-.2500E+05	.1085E+05	-.1335E+03	-.9896E+00	-.2683E+06	-.8207E+06	.1308E+04
.6965E+02	-.2282E+04	-.7143E+01	-.2500E+05	.1086E+05	-.1337E+03	-.9895E+00	-.2682E+06	-.8207E+06	.1306E+04
.6975E+02	-.2284E+04	-.7190E+01	-.2500E+05	.1087E+05	-.1338E+03	-.9894E+00	-.2681E+06	-.8206E+06	.1305E+04
.6985E+02	-.2286E+04	-.7237E+01	-.2500E+05	.1088E+05	-.1339E+03	-.9893E+00	-.2681E+06	-.8206E+06	.1304E+04
.6995E+02	-.2288E+04	-.7284E+01	-.2500E+05	.1089E+05	-.1340E+03	-.9891E+00	-.2680E+06	-.8205E+06	.1303E+04
.7005E+02	-.2291E+04	-.7331E+01	-.2500E+05	.1090E+05	-.1342E+03	-.9890E+00	-.2680E+06	-.8205E+06	.1302E+04
.7015E+02	-.2293E+04	-.7377E+01	-.2500E+05	.1091E+05	-.1343E+03	-.9889E+00	-.2679E+06	-.8204E+06	.1300E+04
.7025E+02	-.2295E+04	-.7424E+01	-.2500E+05	.1092E+05	-.1344E+03	-.9888E+00	-.2678E+06	-.8203E+06	.1299E+04
.7035E+02	-.2297E+04	-.7471E+01	-.2500E+05	.1093E+05	-.1345E+03	-.9887E+00	-.2678E+06	-.8203E+06	.1298E+04
.7045E+02	-.2299E+04	-.7517E+01	-.2500E+05	.1094E+05	-.1347E+03	-.9885E+00	-.2677E+06	-.8202E+06	.1297E+04
.7055E+02	-.2301E+04	-.7564E+01	-.2500E+05	.1096E+05	-.1348E+03	-.9884E+00	-.2677E+06	-.8201E+06	.1295E+04
.7065E+02	-.2304E+04	-.7610E+01	-.2500E+05	.1097E+05	-.1349E+03	-.9883E+00	-.2676E+06	-.8201E+06	.1294E+04
.7075E+02	-.2306E+04	-.7657E+01	-.2500E+05	.1098E+05	-.1350E+03	-.9882E+00	-.2675E+06	-.8200E+06	.1293E+04
.7085E+02	-.2308E+04	-.7703E+01	-.2500E+05	.1099E+05	-.1352E+03	-.9881E+00	-.2675E+06	-.8199E+06	.1291E+04
.7095E+02	-.2310E+04	-.7749E+01	-.2500E+05	.1100E+05	-.1353E+03	-.9880E+00	-.2674E+06	-.8198E+06	.1290E+04
.7105E+02	-.2313E+04	-.7796E+01	-.2500E+05	.1101E+05	-.1354E+03	-.9878E+00	-.2673E+06	-.8198E+06	.1289E+04
.7115E+02	-.2315E+04	-.7842E+01	-.2500E+05	.1102E+05	-.1356E+03	-.9877E+00	-.2673E+06	-.8197E+06	.1287E+04
.7125E+02	-.2317E+04	-.7888E+01	-.2500E+05	.1103E+05	-.1357E+03	-.9876E+00	-.2672E+06	-.8196E+06	.1286E+04
.7135E+02	-.2319E+04	-.7934E+01	-.2500E+05	.1104E+05	-.1358E+03	-.9875E+00	-.2671E+06	-.8196E+06	.1285E+04
.7145E+02	-.2322E+04	-.7980E+01	-.2500E+05	.1105E+05	-.1360E+03	-.9874E+00	-.2671E+06	-.8196E+06	.1283E+04
.7155E+02	-.2324E+04	-.8026E+01	-.2500E+05	.1106E+05	-.1361E+03	-.9872E+00	-.2671E+06	-.8197E+06	.1282E+04
.7165E+02	-.2326E+04	-.8072E+01	-.2500E+05	.1107E+05	-.1362E+03	-.9871E+00	-.2671E+06	-.8197E+06	.1281E+04
.7175E+02	-.2328E+04	-.8118E+01	-.2500E+05	.1108E+05	-.1363E+03	-.9870E+00	-.2670E+06	-.8197E+06	.1279E+04
.7185E+02	-.2330E+04	-.8164E+01	-.2500E+05	.1109E+05	-.1365E+03	-.9869E+00	-.2670E+06	-.8197E+06	.1278E+04
.7195E+02	-.2333E+04	-.8210E+01	-.2500E+05	.1110E+05	-.1366E+03	-.9868E+00	-.2670E+06	-.8197E+06	.1277E+04
.7205E+02	-.2335E+04	-.8255E+01	-.2500E+05	.1111E+05	-.1367E+03	-.9866E+00	-.2669E+06	-.8197E+06	.1275E+04
.7215E+02	-.2337E+04	-.8301E+01	-.2500E+05	.1112E+05	-.1369E+03	-.9865E+00	-.2669E+06	-.8197E+06	.1274E+04
.7225E+02	-.2339E+04	-.8346E+01	-.2500E+05	.1113E+05	-.1370E+03	-.9864E+00	-.2668E+06	-.8197E+06	.1272E+04
.7235E+02	-.2341E+04	-.8392E+01	-.2500E+05	.1115E+05	-.1371E+03	-.9863E+00	-.2668E+06	-.8196E+06	.1271E+04
.7245E+02	-.2344E+04	-.8437E+01	-.2500E+05	.1116E+05	-.1372E+03	-.9862E+00	-.2667E+06	-.8196E+06	.1270E+04
.7255E+02	-.2346E+04	-.8483E+01	-.2500E+05	.1117E+05	-.1374E+03	-.9860E+00	-.2667E+06	-.8196E+06	.1268E+04
.7265E+02	-.2348E+04	-.8528E+01	-.2500E+05	.1118E+05	-.1375E+03	-.9859E+00	-.2666E+06	-.8195E+06	.1267E+04
.7275E+02	-.2350E+04	-.8573E+01	-.2500E+05	.1119E+05	-.1376E+03	-.9858E+00	-.2666E+06	-.8195E+06	.1265E+04
.7285E+02	-.2352E+04	-.8618E+01	-.2500E+05	.1120E+05	-.1378E+03	-.9857E+00	-.2665E+06	-.8194E+06	.1264E+04
.7295E+02	-.2355E+04	-.8663E+01	-.2500E+05	.1121E+05	-.1379E+03	-.9856E+00	-.2665E+06	-.8194E+06	.1262E+04
.7305E+02	-.2357E+04	-.8708E+01	-.2500E+05	.1122E+05	-.1380E+03	-.9854E+00	-.2664E+06	-.8193E+06	.1261E+04
.7315E+02	-.2359E+04	-.8753E+01	-.2500E+05	.1123E+05	-.1382E+03	-.9853E+00	-.2663E+06	-.8193E+06	.1259E+04
.7325E+02	-.2361E+04	-.8798E+01	-.2500E+05	.1124E+05	-.1383E+03	-.9852E+00	-.2663E+06	-.8192E+06	.1258E+04
.7335E+02	-.2364E+04	-.8843E+01	-.2500E+05	.1125E+05	-.1384E+03	-.9851E+00	-.2662E+06	-.8192E+06	.1256E+04
.7345E+02	-.2366E+04	-.8888E+01	-.2500E+05	.1126E+05	-.1386E+03	-.9850E+00	-.2662E+06	-.8191E+06	.1255E+04
.7355E+02	-.2368E+04	-.8932E+01	-.2500E+05	.1127E+05	-.1387E+03	-.9848E+00	-.2661E+06	-.8191E+06	.1253E+04
.7365E+02	-.2370E+04	-.8977E+01	-.2500E+05	.1128E+05	-.1388E+03	-.9847E+00	-.2661E+06	-.8190E+06	.1252E+04
.7375E+02	-.2372E+04	-.9021E+01	-.2500E+05	.1129E+05	-.1389E+03	-.9846E+00	-.2660E+06	-.8190E+06	.1250E+04
.7385E+02	-.2375E+04	-.9065E+01	-.2500E+05	.1130E+05	-.1391E+03	-.9845E+00	-.2659E+06	-.8189E+06	.1249E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.7395E+02	-.2377E+04	-.9110E+01	-.2500E+05	.1131E+05	-.1392E+03	-.9844E+00	-.2659E+06	-.8189E+05	.1247E+04
.7405E+02	-.2379E+04	-.9154E+01	-.2500E+05	.1133E+05	-.1393E+03	-.9842E+00	-.2658E+06	-.8188E+06	.1246E+04
.7415E+02	-.2382E+04	-.9198E+01	-.2500E+05	.1134E+05	-.1395E+03	-.9841E+00	-.2658E+06	-.8188E+06	.1244E+04
.7425E+02	-.2384E+04	-.9242E+01	-.2500E+05	.1135E+05	-.1396E+03	-.9840E+00	-.2657E+06	-.8187E+06	.1243E+04
.7435E+02	-.2386E+04	-.9286E+01	-.2500E+05	.1136E+05	-.1397E+03	-.9839E+00	-.2657E+06	-.8187E+06	.1241E+04
.7445E+02	-.2388E+04	-.9330E+01	-.2500E+05	.1137E+05	-.1399E+03	-.9838E+00	-.2656E+06	-.8188E+06	.1240E+04
.7455E+02	-.2391E+04	-.9374E+01	-.2500E+05	.1138E+05	-.1400E+03	-.9836E+00	-.2656E+06	-.8189E+06	.1238E+04
.7465E+02	-.2393E+04	-.9417E+01	-.2500E+05	.1139E+05	-.1401E+03	-.9835E+00	-.2656E+06	-.8190E+06	.1236E+04
.7475E+02	-.2395E+04	-.9461E+01	-.2500E+05	.1140E+05	-.1403E+03	-.9834E+00	-.2655E+06	-.8190E+06	.1235E+04
.7485E+02	-.2397E+04	-.9505E+01	-.2500E+05	.1141E+05	-.1404E+03	-.9833E+00	-.2655E+06	-.8190E+06	.1233E+04
.7495E+02	-.2399E+04	-.9548E+01	-.2500E+05	.1142E+05	-.1405E+03	-.9832E+00	-.2654E+06	-.8191E+06	.1232E+04
.7505E+02	-.2402E+04	-.9592E+01	-.2500E+05	.1143E+05	-.1407E+03	-.9830E+00	-.2654E+06	-.8191E+06	.1230E+04
.7515E+02	-.2404E+04	-.9635E+01	-.2500E+05	.1144E+05	-.1408E+03	-.9829E+00	-.2653E+06	-.8191E+06	.1228E+04
.7525E+02	-.2406E+04	-.9678E+01	-.2500E+05	.1145E+05	-.1409E+03	-.9828E+00	-.2653E+06	-.8191E+06	.1227E+04
.7535E+02	-.2408E+04	-.9721E+01	-.2500E+05	.1146E+05	-.1410E+03	-.9827E+00	-.2652E+06	-.8191E+06	.1225E+04
.7545E+02	-.2410E+04	-.9764E+01	-.2500E+05	.1147E+05	-.1412E+03	-.9826E+00	-.2651E+06	-.8191E+06	.1223E+04
.7555E+02	-.2412E+04	-.9807E+01	-.2500E+05	.1148E+05	-.1413E+03	-.9825E+00	-.2651E+06	-.8191E+06	.1222E+04
.7565E+02	-.2415E+04	-.9850E+01	-.2500E+05	.1149E+05	-.1414E+03	-.9823E+00	-.2650E+06	-.8190E+06	.1220E+04
.7575E+02	-.2417E+04	-.9893E+01	-.2500E+05	.1150E+05	-.1415E+03	-.9822E+00	-.2649E+06	-.8190E+06	.1218E+04
.7585E+02	-.2419E+04	-.9936E+01	-.2500E+05	.1151E+05	-.1417E+03	-.9821E+00	-.2649E+06	-.8190E+06	.1217E+04
.7595E+02	-.2421E+04	-.9978E+01	-.2500E+05	.1152E+05	-.1418E+03	-.9820E+00	-.2648E+06	-.8190E+06	.1215E+04
.7605E+02	-.2423E+04	-.1002E+02	-.2500E+05	.1153E+05	-.1419E+03	-.9819E+00	-.2647E+06	-.8189E+06	.1213E+04
.7615E+02	-.2425E+04	-.1006E+02	-.2500E+05	.1155E+05	-.1420E+03	-.9817E+00	-.2647E+06	-.8189E+06	.1212E+04
.7625E+02	-.2428E+04	-.1011E+02	-.2500E+05	.1156E+05	-.1422E+03	-.9816E+00	-.2646E+06	-.8189E+06	.1210E+04
.7635E+02	-.2430E+04	-.1015E+02	-.2500E+05	.1157E+05	-.1423E+03	-.9815E+00	-.2645E+06	-.8188E+06	.1208E+04
.7645E+02	-.2432E+04	-.1019E+02	-.2500E+05	.1158E+05	-.1424E+03	-.9814E+00	-.2644E+06	-.8188E+06	.1207E+04
.7655E+02	-.2434E+04	-.1023E+02	-.2500E+05	.1159E+05	-.1426E+03	-.9813E+00	-.2644E+06	-.8188E+06	.1205E+04
.7665E+02	-.2436E+04	-.1027E+02	-.2500E+05	.1160E+05	-.1427E+03	-.9812E+00	-.2643E+06	-.8187E+06	.1203E+04
.7675E+02	-.2438E+04	-.1032E+02	-.2500E+05	.1161E+05	-.1428E+03	-.9810E+00	-.2642E+06	-.8187E+06	.1201E+04
.7685E+02	-.2441E+04	-.1036E+02	-.2500E+05	.1162E+05	-.1429E+03	-.9809E+00	-.2642E+06	-.8187E+06	.1200E+04
.7695E+02	-.2443E+04	-.1040E+02	-.2500E+05	.1163E+05	-.1431E+03	-.9808E+00	-.2641E+06	-.8186E+06	.1198E+04
.7705E+02	-.2445E+04	-.1044E+02	-.2500E+05	.1164E+05	-.1432E+03	-.9807E+00	-.2640E+06	-.8186E+06	.1196E+04
.7715E+02	-.2447E+04	-.1048E+02	-.2500E+05	.1165E+05	-.1433E+03	-.9806E+00	-.2639E+06	-.8186E+06	.1194E+04
.7725E+02	-.2449E+04	-.1052E+02	-.2500E+05	.1166E+05	-.1434E+03	-.9805E+00	-.2639E+06	-.8185E+06	.1193E+04
.7735E+02	-.2451E+04	-.1057E+02	-.2500E+05	.1167E+05	-.1436E+03	-.9803E+00	-.2638E+06	-.8185E+06	.1191E+04
.7745E+02	-.2454E+04	-.1061E+02	-.2500E+05	.1168E+05	-.1437E+03	-.9802E+00	-.2637E+06	-.8185E+06	.1189E+04
.7755E+02	-.2456E+04	-.1065E+02	-.2500E+05	.1169E+05	-.1438E+03	-.9801E+00	-.2636E+06	-.8184E+06	.1187E+04
.7765E+02	-.2458E+04	-.1069E+02	-.2500E+05	.1170E+05	-.1440E+03	-.9800E+00	-.2636E+06	-.8184E+06	.1185E+04
.7775E+02	-.2460E+04	-.1073E+02	-.2500E+05	.1171E+05	-.1441E+03	-.9799E+00	-.2635E+06	-.8184E+06	.1184E+04
.7785E+02	-.2462E+04	-.1077E+02	-.2500E+05	.1172E+05	-.1442E+03	-.9798E+00	-.2634E+06	-.8183E+06	.1182E+04
.7795E+02	-.2465E+04	-.1081E+02	-.2500E+05	.1173E+05	-.1443E+03	-.9797E+00	-.2634E+06	-.8183E+06	.1180E+04
.7805E+02	-.2467E+04	-.1085E+02	-.2500E+05	.1174E+05	-.1445E+03	-.9795E+00	-.2633E+06	-.8184E+06	.1178E+04
.7815E+02	-.2469E+04	-.1089E+02	-.2500E+05	.1175E+05	-.1446E+03	-.9794E+00	-.2633E+06	-.8184E+06	.1176E+04
.7825E+02	-.2471E+04	-.1093E+02	-.2500E+05	.1176E+05	-.1447E+03	-.9793E+00	-.2633E+06	-.8185E+06	.1175E+04
.7835E+02	-.2473E+04	-.1097E+02	-.2500E+05	.1177E+05	-.1448E+03	-.9792E+00	-.2632E+06	-.8185E+06	.1173E+04
.7845E+02	-.2475E+04	-.1101E+02	-.2500E+05	.1178E+05	-.1450E+03	-.9791E+00	-.2632E+06	-.8185E+06	.1171E+04
.7855E+02	-.2477E+04	-.1105E+02	-.2500E+05	.1179E+05	-.1451E+03	-.9790E+00	-.2632E+06	-.8185E+06	.1169E+04
.7865E+02	-.2480E+04	-.1109E+02	-.2500E+05	.1180E+05	-.1452E+03	-.9789E+00	-.2631E+06	-.8185E+06	.1167E+04
.7875E+02	-.2482E+04	-.1113E+02	-.2500E+05	.1181E+05	-.1453E+03	-.9787E+00	-.2631E+06	-.8185E+06	.1165E+04
.7885E+02	-.2484E+04	-.1117E+02	-.2500E+05	.1182E+05	-.1455E+03	-.9786E+00	-.2630E+06	-.8185E+06	.1163E+04
.7895E+02	-.2486E+04	-.1121E+02	-.2500E+05	.1183E+05	-.1456E+03	-.9785E+00	-.2630E+06	-.8185E+06	.1161E+04
.7905E+02	-.2488E+04	-.1125E+02	-.2500E+05	.1184E+05	-.1457E+03	-.9784E+00	-.2629E+06	-.8185E+06	.1160E+04
.7915E+02	-.2490E+04	-.1129E+02	-.2500E+05	.1185E+05	-.1458E+03	-.9783E+00	-.2629E+06	-.8185E+06	.1158E+04
.7925E+02	-.2492E+04	-.1133E+02	-.2500E+05	.1186E+05	-.1460E+03	-.9782E+00	-.2628E+06	-.8185E+06	.1156E+04
.7935E+02	-.2494E+04	-.1137E+02	-.2500E+05	.1187E+05	-.1461E+03	-.9781E+00	-.2628E+06	-.8185E+06	.1154E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	T2ENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.7945E+02	-.2496E+04	-.1141E+02	-.2500E+05	.1188E+05	-.1462E+03	-.9780E+00	-.2627E+06	-.8185E+06	.1152E+04
.7955E+02	-.2498E+04	-.1145E+02	-.2500E+05	.1189E+05	-.1463E+03	-.9779E+00	-.2627E+06	-.8184E+06	.1150E+04
.7965E+02	-.2501E+04	-.1149E+02	-.2500E+05	.1190E+05	-.1464E+03	-.9777E+00	-.2626E+06	-.8184E+06	.1148E+04
.7975E+02	-.2503E+04	-.1153E+02	-.2500E+05	.1191E+05	-.1466E+03	-.9776E+00	-.2625E+06	-.8184E+06	.1146E+04
.7985E+02	-.2505E+04	-.1157E+02	-.2500E+05	.1192E+05	-.1467E+03	-.9775E+00	-.2625E+06	-.8184E+06	.1144E+04
.7995E+02	-.2507E+04	-.1161E+02	-.2500E+05	.1193E+05	-.1468E+03	-.9774E+00	-.2624E+06	-.8184E+06	.1142E+04
.8005E+02	-.2509E+04	-.1164E+02	-.2500E+05	.1194E+05	-.1469E+03	-.9773E+00	-.2624E+06	-.8183E+06	.1140E+04
.8015E+02	-.2511E+04	-.1168E+02	-.2500E+05	.1195E+05	-.1471E+03	-.9772E+00	-.2623E+06	-.8183E+06	.1138E+04
.8025E+02	-.2513E+04	-.1172E+02	-.2500E+05	.1196E+05	-.1472E+03	-.9771E+00	-.2623E+06	-.8183E+06	.1136E+04
.8035E+02	-.2515E+04	-.1176E+02	-.2500E+05	.1197E+05	-.1473E+03	-.9770E+00	-.2622E+06	-.8183E+06	.1134E+04
.8045E+02	-.2517E+04	-.1180E+02	-.2500E+05	.1198E+05	-.1474E+03	-.9769E+00	-.2622E+06	-.8182E+06	.1132E+04
.8055E+02	-.2519E+04	-.1184E+02	-.2500E+05	.1199E+05	-.1475E+03	-.9768E+00	-.2621E+06	-.8182E+06	.1130E+04
.8065E+02	-.2521E+04	-.1187E+02	-.2500E+05	.1200E+05	-.1477E+03	-.9767E+00	-.2621E+06	-.8182E+06	.1128E+04
.8075E+02	-.2524E+04	-.1191E+02	-.2500E+05	.1201E+05	-.1478E+03	-.9765E+00	-.2620E+06	-.8182E+06	.1126E+04
.8085E+02	-.2526E+04	-.1195E+02	-.2500E+05	.1202E+05	-.1479E+03	-.9764E+00	-.2619E+06	-.8182E+06	.1124E+04
.8095E+02	-.2528E+04	-.1199E+02	-.2500E+05	.1203E+05	-.1480E+03	-.9763E+00	-.2619E+06	-.8181E+06	.1122E+04
.8105E+02	-.2530E+04	-.1203E+02	-.2500E+05	.1204E+05	-.1482E+03	-.9762E+00	-.2618E+06	-.8181E+06	.1120E+04
.8115E+02	-.2532E+04	-.1206E+02	-.2500E+05	.1205E+05	-.1483E+03	-.9761E+00	-.2618E+06	-.8181E+06	.1118E+04
.8125E+02	-.2534E+04	-.1210E+02	-.2500E+05	.1206E+05	-.1484E+03	-.9760E+00	-.2617E+06	-.8181E+06	.1116E+04
.8135E+02	-.2536E+04	-.1214E+02	-.2500E+05	.1207E+05	-.1485E+03	-.9759E+00	-.2617E+06	-.8180E+06	.1114E+04
.8145E+02	-.2538E+04	-.1218E+02	-.2500E+05	.1208E+05	-.1486E+03	-.9758E+00	-.2616E+06	-.8180E+06	.1112E+04
.8155E+02	-.2540E+04	-.1221E+02	-.2500E+05	.1209E+05	-.1488E+03	-.9757E+00	-.2616E+06	-.8180E+06	.1110E+04
.8165E+02	-.2542E+04	-.1225E+02	-.2500E+05	.1210E+05	-.1489E+03	-.9756E+00	-.2615E+06	-.8180E+06	.1108E+04
.8175E+02	-.2544E+04	-.1229E+02	-.2500E+05	.1211E+05	-.1490E+03	-.9755E+00	-.2615E+06	-.8180E+06	.1106E+04
.8185E+02	-.2546E+04	-.1232E+02	-.2500E+05	.1212E+05	-.1491E+03	-.9754E+00	-.2614E+06	-.8179E+06	.1104E+04
.8195E+02	-.2549E+04	-.1236E+02	-.2500E+05	.1213E+05	-.1493E+03	-.9753E+00	-.2613E+06	-.8179E+06	.1102E+04
.8205E+02	-.2551E+04	-.1240E+02	-.2500E+05	.1214E+05	-.1494E+03	-.9752E+00	-.2613E+06	-.8179E+06	.1100E+04
.8215E+02	-.2553E+04	-.1243E+02	-.2500E+05	.1215E+05	-.1495E+03	-.9751E+00	-.2612E+06	-.8179E+06	.1098E+04
.8225E+02	-.2555E+04	-.1247E+02	-.2500E+05	.1216E+05	-.1496E+03	-.9750E+00	-.2612E+06	-.8179E+06	.1095E+04
.8235E+02	-.2557E+04	-.1251E+02	-.2500E+05	.1217E+05	-.1497E+03	-.9749E+00	-.2611E+06	-.8180E+06	.1093E+04
.8245E+02	-.2559E+04	-.1254E+02	-.2500E+05	.1218E+05	-.1499E+03	-.9748E+00	-.2611E+06	-.8180E+06	.1091E+04
.8255E+02	-.2561E+04	-.1258E+02	-.2500E+05	.1219E+05	-.1500E+03	-.9747E+00	-.2610E+06	-.8180E+06	.1089E+04
.8265E+02	-.2563E+04	-.1262E+02	-.2500E+05	.1220E+05	-.1501E+03	-.9746E+00	-.2610E+06	-.8180E+06	.1087E+04
.8275E+02	-.2565E+04	-.1265E+02	-.2500E+05	.1221E+05	-.1502E+03	-.9745E+00	-.2609E+06	-.8180E+06	.1085E+04
.8285E+02	-.2567E+04	-.1269E+02	-.2500E+05	.1222E+05	-.1503E+03	-.9744E+00	-.2609E+06	-.8180E+06	.1083E+04
.8295E+02	-.2569E+04	-.1272E+02	-.2500E+05	.1223E+05	-.1504E+03	-.9743E+00	-.2608E+06	-.8180E+06	.1081E+04
.8305E+02	-.2571E+04	-.1276E+02	-.2500E+05	.1224E+05	-.1506E+03	-.9742E+00	-.2608E+06	-.8180E+06	.1078E+04
.8315E+02	-.2573E+04	-.1279E+02	-.2500E+05	.1225E+05	-.1507E+03	-.9741E+00	-.2607E+06	-.8180E+06	.1076E+04
.8325E+02	-.2575E+04	-.1283E+02	-.2500E+05	.1226E+05	-.1508E+03	-.9740E+00	-.2606E+06	-.8180E+06	.1074E+04
.8335E+02	-.2577E+04	-.1287E+02	-.2500E+05	.1227E+05	-.1509E+03	-.9739E+00	-.2606E+06	-.8180E+06	.1072E+04
.8345E+02	-.2579E+04	-.1290E+02	-.2500E+05	.1228E+05	-.1510E+03	-.9738E+00	-.2605E+06	-.8180E+06	.1070E+04
.8355E+02	-.2581E+04	-.1294E+02	-.2500E+05	.1229E+05	-.1512E+03	-.9737E+00	-.2604E+06	-.8180E+06	.1068E+04
.8365E+02	-.2583E+04	-.1297E+02	-.2500E+05	.1229E+05	-.1513E+03	-.9736E+00	-.2604E+06	-.8180E+06	.1065E+04
.8375E+02	-.2585E+04	-.1301E+02	-.2500E+05	.1230E+05	-.1514E+03	-.9735E+00	-.2603E+06	-.8180E+06	.1063E+04
.8385E+02	-.2587E+04	-.1304E+02	-.2500E+05	.1231E+05	-.1515E+03	-.9734E+00	-.2603E+06	-.8180E+06	.1061E+04
.8395E+02	-.2589E+04	-.1308E+02	-.2500E+05	.1232E+05	-.1516E+03	-.9733E+00	-.2602E+06	-.8180E+06	.1059E+04
.8405E+02	-.2591E+04	-.1311E+02	-.2500E+05	.1233E+05	-.1517E+03	-.9732E+00	-.2601E+06	-.8180E+06	.1057E+04
.8415E+02	-.2593E+04	-.1314E+02	-.2500E+05	.1234E+05	-.1518E+03	-.9731E+00	-.2601E+06	-.8179E+06	.1054E+04
.8425E+02	-.2595E+04	-.1318E+02	-.2500E+05	.1235E+05	-.1520E+03	-.9730E+00	-.2600E+06	-.8179E+06	.1052E+04
.8435E+02	-.2597E+04	-.1321E+02	-.2500E+05	.1236E+05	-.1521E+03	-.9729E+00	-.2599E+06	-.8179E+06	.1050E+04
.8445E+02	-.2599E+04	-.1325E+02	-.2500E+05	.1237E+05	-.1522E+03	-.9728E+00	-.2599E+06	-.8179E+06	.1048E+04
.8455E+02	-.2601E+04	-.1328E+02	-.2500E+05	.1238E+05	-.1523E+03	-.9727E+00	-.2598E+06	-.8179E+06	.1045E+04
.8465E+02	-.2603E+04	-.1331E+02	-.2500E+05	.1239E+05	-.1524E+03	-.9726E+00	-.2598E+06	-.8179E+06	.1043E+04
.8475E+02	-.2605E+04	-.1335E+02	-.2500E+05	.1240E+05	-.1525E+03	-.9725E+00	-.2597E+06	-.8179E+06	.1041E+04
.8485E+02	-.2606E+04	-.1338E+02	-.2500E+05	.1241E+05	-.1526E+03	-.9724E+00	-.2596E+06	-.8179E+06	.1039E+04

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.8495E+02	-.2608E+04	-.1342E+02	-.2500E+05	.1242E+05	-.1528E+03	-.9723E+00	-.2596E+06	-.8179E+06	.1036E+04
.8505E+02	-.2610E+04	-.1345E+02	-.2500E+05	.1243E+05	-.1529E+03	-.9723E+00	-.2595E+06	-.8178E+06	.1034E+04
.8515E+02	-.2612E+04	-.1348E+02	-.2500E+05	.1243E+05	-.1530E+03	-.9722E+00	-.2594E+06	-.8178E+06	.1032E+04
.8525E+02	-.2614E+04	-.1352E+02	-.2500E+05	.1244E+05	-.1531E+03	-.9721E+00	-.2594E+06	-.8178E+06	.1030E+04
.8535E+02	-.2616E+04	-.1355E+02	-.2500E+05	.1245E+05	-.1532E+03	-.9720E+00	-.2593E+06	-.8178E+06	.1027E+04
.8545E+02	-.2618E+04	-.1358E+02	-.2500E+05	.1246E+05	-.1533E+03	-.9719E+00	-.2593E+06	-.8178E+06	.1025E+04
.8555E+02	-.2620E+04	-.1362E+02	-.2500E+05	.1247E+05	-.1534E+03	-.9718E+00	-.2592E+06	-.8178E+06	.1023E+04
.8565E+02	-.2622E+04	-.1365E+02	-.2500E+05	.1248E+05	-.1536E+03	-.9717E+00	-.2591E+06	-.8178E+06	.1020E+04
.8575E+02	-.2624E+04	-.1368E+02	-.2500E+05	.1249E+05	-.1537E+03	-.9716E+00	-.2591E+06	-.8178E+06	.1018E+04
.8585E+02	-.2626E+04	-.1371E+02	-.2500E+05	.1250E+05	-.1538E+03	-.9715E+00	-.2590E+06	-.8178E+06	.1016E+04
.8595E+02	-.2628E+04	-.1375E+02	-.2500E+05	.1251E+05	-.1539E+03	-.9714E+00	-.2589E+06	-.8178E+06	.1014E+04
.8605E+02	-.2630E+04	-.1378E+02	-.2500E+05	.1252E+05	-.1540E+03	-.9713E+00	-.2589E+06	-.8177E+06	.1011E+04
.8615E+02	-.2632E+04	-.1381E+02	-.2500E+05	.1253E+05	-.1541E+03	-.9713E+00	-.2588E+06	-.8177E+06	.1009E+04
.8625E+02	-.2634E+04	-.1384E+02	-.2500E+05	.1254E+05	-.1542E+03	-.9712E+00	-.2588E+06	-.8177E+06	.1007E+04
.8635E+02	-.2635E+04	-.1388E+02	-.2500E+05	.1254E+05	-.1543E+03	-.9711E+00	-.2587E+06	-.8177E+06	.1004E+04
.8645E+02	-.2637E+04	-.1391E+02	-.2500E+05	.1255E+05	-.1545E+03	-.9710E+00	-.2586E+06	-.8177E+06	.1002E+04
.8655E+02	-.2639E+04	-.1394E+02	-.2500E+05	.1256E+05	-.1546E+03	-.9709E+00	-.2586E+06	-.8177E+06	.9995E+03
.8665E+02	-.2641E+04	-.1397E+02	-.2500E+05	.1257E+05	-.1547E+03	-.9708E+00	-.2585E+06	-.8177E+06	.9971E+03
.8675E+02	-.2643E+04	-.1400E+02	-.2500E+05	.1258E+05	-.1548E+03	-.9707E+00	-.2585E+06	-.8177E+06	.9948E+03
.8685E+02	-.2645E+04	-.1403E+02	-.2500E+05	.1259E+05	-.1549E+03	-.9706E+00	-.2584E+06	-.8177E+06	.9924E+03
.8695E+02	-.2647E+04	-.1407E+02	-.2500E+05	.1260E+05	-.1550E+03	-.9706E+00	-.2583E+06	-.8177E+06	.9900E+03
.8705E+02	-.2649E+04	-.1410E+02	-.2500E+05	.1261E+05	-.1551E+03	-.9705E+00	-.2583E+06	-.8177E+06	.9877E+03
.8715E+02	-.2651E+04	-.1413E+02	-.2500E+05	.1262E+05	-.1552E+03	-.9704E+00	-.2582E+06	-.8177E+06	.9853E+03
.8725E+02	-.2653E+04	-.1416E+02	-.2500E+05	.1263E+05	-.1553E+03	-.9703E+00	-.2582E+06	-.8177E+06	.9829E+03
.8735E+02	-.2654E+04	-.1419E+02	-.2500E+05	.1264E+05	-.1555E+03	-.9702E+00	-.2581E+06	-.8176E+06	.9805E+03
.8745E+02	-.2656E+04	-.1422E+02	-.2500E+05	.1264E+05	-.1556E+03	-.9701E+00	-.2580E+06	-.8176E+06	.9781E+03
.8755E+02	-.2658E+04	-.1425E+02	-.2500E+05	.1265E+05	-.1557E+03	-.9701E+00	-.2580E+06	-.8177E+06	.9757E+03
.8765E+02	-.2660E+04	-.1428E+02	-.2500E+05	.1266E+05	-.1558E+03	-.9700E+00	-.2580E+06	-.8177E+06	.9733E+03
.8775E+02	-.2662E+04	-.1431E+02	-.2500E+05	.1267E+05	-.1559E+03	-.9699E+00	-.2579E+06	-.8178E+06	.9709E+03
.8785E+02	-.2664E+04	-.1434E+02	-.2500E+05	.1268E+05	-.1560E+03	-.9698E+00	-.2579E+06	-.8178E+06	.9685E+03
.8795E+02	-.2665E+04	-.1437E+02	-.2500E+05	.1269E+05	-.1561E+03	-.9697E+00	-.2578E+06	-.8178E+06	.9660E+03
.8805E+02	-.2667E+04	-.1440E+02	-.2500E+05	.1270E+05	-.1562E+03	-.9696E+00	-.2578E+06	-.8179E+06	.9636E+03
.8815E+02	-.2669E+04	-.1443E+02	-.2500E+05	.1271E+05	-.1563E+03	-.9696E+00	-.2578E+06	-.8179E+06	.9612E+03
.8825E+02	-.2671E+04	-.1446E+02	-.2500E+05	.1271E+05	-.1564E+03	-.9695E+00	-.2577E+06	-.8179E+06	.9587E+03
.8835E+02	-.2673E+04	-.1449E+02	-.2500E+05	.1272E+05	-.1565E+03	-.9694E+00	-.2577E+06	-.8179E+06	.9563E+03
.8845E+02	-.2674E+04	-.1452E+02	-.2500E+05	.1273E+05	-.1566E+03	-.9693E+00	-.2576E+06	-.8179E+06	.9538E+03
.8855E+02	-.2676E+04	-.1455E+02	-.2500E+05	.1274E+05	-.1567E+03	-.9692E+00	-.2576E+06	-.8179E+06	.9514E+03
.8865E+02	-.2678E+04	-.1458E+02	-.2500E+05	.1275E+05	-.1568E+03	-.9691E+00	-.2575E+06	-.8179E+06	.9489E+03
.8875E+02	-.2680E+04	-.1461E+02	-.2500E+05	.1276E+05	-.1569E+03	-.9691E+00	-.2575E+06	-.8179E+06	.9465E+03
.8885E+02	-.2681E+04	-.1464E+02	-.2500E+05	.1276E+05	-.1570E+03	-.9690E+00	-.2574E+06	-.8179E+06	.9440E+03
.8895E+02	-.2683E+04	-.1467E+02	-.2500E+05	.1277E+05	-.1571E+03	-.9689E+00	-.2574E+06	-.8179E+06	.9415E+03
.8905E+02	-.2685E+04	-.1470E+02	-.2500E+05	.1278E+05	-.1572E+03	-.9688E+00	-.2573E+06	-.8180E+06	.9390E+03
.8915E+02	-.2687E+04	-.1473E+02	-.2500E+05	.1279E+05	-.1573E+03	-.9687E+00	-.2573E+06	-.8180E+06	.9366E+03
.8925E+02	-.2688E+04	-.1476E+02	-.2500E+05	.1280E+05	-.1575E+03	-.9687E+00	-.2572E+06	-.8180E+06	.9341E+03
.8935E+02	-.2690E+04	-.1479E+02	-.2500E+05	.1281E+05	-.1576E+03	-.9686E+00	-.2572E+06	-.8180E+06	.9316E+03
.8945E+02	-.2692E+04	-.1482E+02	-.2500E+05	.1281E+05	-.1577E+03	-.9685E+00	-.2572E+06	-.8180E+06	.9291E+03
.8955E+02	-.2694E+04	-.1485E+02	-.2500E+05	.1282E+05	-.1578E+03	-.9684E+00	-.2571E+06	-.8180E+06	.9266E+03
.8965E+02	-.2695E+04	-.1488E+02	-.2500E+05	.1283E+05	-.1579E+03	-.9684E+00	-.2571E+06	-.8180E+06	.9241E+03
.8975E+02	-.2697E+04	-.1490E+02	-.2500E+05	.1284E+05	-.1580E+03	-.9683E+00	-.2570E+06	-.8180E+06	.9215E+03
.8985E+02	-.2699E+04	-.1493E+02	-.2500E+05	.1285E+05	-.1581E+03	-.9682E+00	-.2570E+06	-.8180E+06	.9190E+03
.8995E+02	-.2701E+04	-.1496E+02	-.2500E+05	.1285E+05	-.1582E+03	-.9681E+00	-.2569E+06	-.8179E+06	.9165E+03
.9005E+02	-.2702E+04	-.1499E+02	-.2500E+05	.1286E+05	-.1583E+03	-.9680E+00	-.2569E+06	-.8179E+06	.9140E+03
.9015E+02	-.2704E+04	-.1502E+02	-.2500E+05	.1287E+05	-.1584E+03	-.9680E+00	-.2568E+06	-.8179E+06	.9114E+03
.9025E+02	-.2706E+04	-.1505E+02	-.2500E+05	.1288E+05	-.1585E+03	-.9679E+00	-.2568E+06	-.8179E+06	.9089E+03
.9035E+02	-.2707E+04	-.1507E+02	-.2500E+05	.1289E+05	-.1586E+03	-.9678E+00	-.2567E+06	-.8179E+06	.9064E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TQENG=	PWRENG=	XNPROP=	SHADVP=	THPROP=	TQPROP=	REACH=
.9045E+02	-.2709E+04	-.1510E+02	-.2500E+05	.1290E+05	-.1587E+03	-.9677E+00	-.2567E+06	-.8179E+06	.9038E+03
.9055E+02	-.2711E+04	-.1513E+02	-.2500E+05	.1290E+05	-.1588E+03	-.9677E+00	-.2566E+06	-.8179E+06	.9013E+03
.9065E+02	-.2712E+04	-.1516E+02	-.2500E+05	.1291E+05	-.1589E+03	-.9676E+00	-.2566E+06	-.8179E+06	.8987E+03
.9075E+02	-.2714E+04	-.1518E+02	-.2500E+05	.1292E+05	-.1589E+03	-.9675E+00	-.2565E+06	-.8179E+06	.8962E+03
.9085E+02	-.2716E+04	-.1521E+02	-.2500E+05	.1293E+05	-.1590E+03	-.9674E+00	-.2565E+06	-.8179E+06	.8936E+03
.9095E+02	-.2717E+04	-.1524E+02	-.2500E+05	.1294E+05	-.1591E+03	-.9674E+00	-.2564E+06	-.8179E+06	.8910E+03
.9105E+02	-.2719E+04	-.1527E+02	-.2500E+05	.1294E+05	-.1592E+03	-.9673E+00	-.2564E+06	-.8179E+06	.8884E+03
.9115E+02	-.2721E+04	-.1529E+02	-.2500E+05	.1295E+05	-.1593E+03	-.9672E+00	-.2563E+06	-.8179E+06	.8859E+03
.9125E+02	-.2722E+04	-.1532E+02	-.2500E+05	.1296E+05	-.1594E+03	-.9672E+00	-.2563E+06	-.8179E+06	.8833E+03
.9135E+02	-.2724E+04	-.1535E+02	-.2500E+05	.1297E+05	-.1595E+03	-.9671E+00	-.2562E+06	-.8179E+06	.8807E+03
.9145E+02	-.2726E+04	-.1537E+02	-.2500E+05	.1297E+05	-.1596E+03	-.9670E+00	-.2562E+06	-.8179E+06	.8781E+03
.9155E+02	-.2727E+04	-.1540E+02	-.2500E+05	.1298E+05	-.1597E+03	-.9669E+00	-.2561E+06	-.8179E+06	.8755E+03
.9165E+02	-.2729E+04	-.1543E+02	-.2500E+05	.1299E+05	-.1598E+03	-.9669E+00	-.2561E+06	-.8179E+06	.8729E+03
.9175E+02	-.2731E+04	-.1545E+02	-.2500E+05	.1300E+05	-.1599E+03	-.9668E+00	-.2561E+06	-.8179E+06	.8703E+03
.9185E+02	-.2732E+04	-.1548E+02	-.2500E+05	.1301E+05	-.1600E+03	-.9667E+00	-.2560E+06	-.8179E+06	.8677E+03
.9195E+02	-.2734E+04	-.1551E+02	-.2500E+05	.1301E+05	-.1601E+03	-.9667E+00	-.2560E+06	-.8179E+06	.8651E+03
.9205E+02	-.2735E+04	-.1553E+02	-.2500E+05	.1302E+05	-.1602E+03	-.9666E+00	-.2559E+06	-.8179E+06	.8625E+03
.9215E+02	-.2737E+04	-.1556E+02	-.2500E+05	.1303E+05	-.1603E+03	-.9665E+00	-.2559E+06	-.8179E+06	.8598E+03
.9225E+02	-.2739E+04	-.1558E+02	-.2500E+05	.1304E+05	-.1604E+03	-.9665E+00	-.2558E+06	-.8179E+06	.8572E+03
.9235E+02	-.2740E+04	-.1561E+02	-.2500E+05	.1304E+05	-.1605E+03	-.9664E+00	-.2558E+06	-.8179E+06	.8546E+03
.9245E+02	-.2742E+04	-.1564E+02	-.2500E+05	.1305E+05	-.1606E+03	-.9663E+00	-.2557E+06	-.8179E+06	.8519E+03
.9255E+02	-.2744E+04	-.1566E+02	-.2500E+05	.1306E+05	-.1607E+03	-.9663E+00	-.2557E+06	-.8179E+06	.8493E+03
.9265E+02	-.2745E+04	-.1569E+02	-.2500E+05	.1307E+05	-.1608E+03	-.9662E+00	-.2556E+06	-.8179E+06	.8466E+03
.9275E+02	-.2747E+04	-.1571E+02	-.2500E+05	.1307E+05	-.1609E+03	-.9661E+00	-.2556E+06	-.8179E+06	.8440E+03
.9285E+02	-.2748E+04	-.1574E+02	-.2500E+05	.1308E+05	-.1610E+03	-.9660E+00	-.2556E+06	-.8179E+06	.8413E+03
.9295E+02	-.2750E+04	-.1576E+02	-.2500E+05	.1309E+05	-.1610E+03	-.9660E+00	-.2555E+06	-.8179E+06	.8387E+03
.9305E+02	-.2751E+04	-.1579E+02	-.2500E+05	.1310E+05	-.1611E+03	-.9659E+00	-.2555E+06	-.8180E+06	.8360E+03
.9315E+02	-.2753E+04	-.1581E+02	-.2500E+05	.1310E+05	-.1612E+03	-.9659E+00	-.2554E+06	-.8180E+06	.8334E+03
.9325E+02	-.2755E+04	-.1584E+02	-.2500E+05	.1311E+05	-.1613E+03	-.9658E+00	-.2554E+06	-.8180E+06	.8307E+03
.9335E+02	-.2756E+04	-.1586E+02	-.2500E+05	.1312E+05	-.1614E+03	-.9657E+00	-.2553E+06	-.8180E+06	.8280E+03
.9345E+02	-.2758E+04	-.1589E+02	-.2500E+05	.1313E+05	-.1615E+03	-.9657E+00	-.2553E+06	-.8180E+06	.8253E+03
.9355E+02	-.2759E+04	-.1591E+02	-.2500E+05	.1313E+05	-.1616E+03	-.9656E+00	-.2552E+06	-.8180E+06	.8226E+03
.9365E+02	-.2761E+04	-.1594E+02	-.2500E+05	.1314E+05	-.1617E+03	-.9655E+00	-.2552E+06	-.8180E+06	.8200E+03
.9375E+02	-.2762E+04	-.1596E+02	-.2500E+05	.1315E+05	-.1618E+03	-.9655E+00	-.2552E+06	-.8180E+06	.8173E+03
.9385E+02	-.2764E+04	-.1599E+02	-.2500E+05	.1316E+05	-.1619E+03	-.9654E+00	-.2551E+06	-.8180E+06	.8146E+03
.9395E+02	-.2766E+04	-.1601E+02	-.2500E+05	.1316E+05	-.1620E+03	-.9653E+00	-.2551E+06	-.8180E+06	.8119E+03
.9405E+02	-.2767E+04	-.1603E+02	-.2500E+05	.1317E+05	-.1621E+03	-.9653E+00	-.2550E+06	-.8180E+06	.8092E+03
.9415E+02	-.2769E+04	-.1606E+02	-.2500E+05	.1318E+05	-.1621E+03	-.9652E+00	-.2550E+06	-.8180E+06	.8065E+03
.9425E+02	-.2770E+04	-.1608E+02	-.2500E+05	.1319E+05	-.1622E+03	-.9652E+00	-.2550E+06	-.8180E+06	.8037E+03
.9435E+02	-.2772E+04	-.1611E+02	-.2500E+05	.1319E+05	-.1623E+03	-.9651E+00	-.2549E+06	-.8180E+06	.8010E+03
.9445E+02	-.2773E+04	-.1613E+02	-.2500E+05	.1320E+05	-.1624E+03	-.9650E+00	-.2549E+06	-.8180E+06	.7983E+03
.9455E+02	-.2775E+04	-.1615E+02	-.2500E+05	.1321E+05	-.1625E+03	-.9650E+00	-.2548E+06	-.8180E+06	.7956E+03
.9465E+02	-.2776E+04	-.1618E+02	-.2500E+05	.1321E+05	-.1626E+03	-.9649E+00	-.2548E+06	-.8180E+06	.7929E+03
.9475E+02	-.2778E+04	-.1620E+02	-.2500E+05	.1322E+05	-.1627E+03	-.9648E+00	-.2548E+06	-.8181E+06	.7901E+03
.9485E+02	-.2779E+04	-.1622E+02	-.2500E+05	.1323E+05	-.1628E+03	-.9648E+00	-.2547E+06	-.8181E+06	.7874E+03
.9495E+02	-.2781E+04	-.1625E+02	-.2500E+05	.1324E+05	-.1628E+03	-.9647E+00	-.2547E+06	-.8181E+06	.7846E+03
.9505E+02	-.2782E+04	-.1627E+02	-.2500E+05	.1324E+05	-.1629E+03	-.9647E+00	-.2547E+06	-.8182E+06	.7819E+03
.9515E+02	-.2783E+04	-.1629E+02	-.2500E+05	.1325E+05	-.1630E+03	-.9646E+00	-.2546E+06	-.8182E+06	.7792E+03
.9525E+02	-.2785E+04	-.1632E+02	-.2500E+05	.1326E+05	-.1631E+03	-.9645E+00	-.2546E+06	-.8183E+06	.7764E+03
.9535E+02	-.2786E+04	-.1634E+02	-.2500E+05	.1326E+05	-.1632E+03	-.9645E+00	-.2546E+06	-.8183E+06	.7736E+03
.9545E+02	-.2788E+04	-.1636E+02	-.2500E+05	.1327E+05	-.1633E+03	-.9644E+00	-.2545E+06	-.8183E+06	.7709E+03
.9555E+02	-.2789E+04	-.1638E+02	-.2500E+05	.1328E+05	-.1633E+03	-.9644E+00	-.2545E+06	-.8184E+06	.7681E+03
.9565E+02	-.2791E+04	-.1641E+02	-.2500E+05	.1328E+05	-.1634E+03	-.9643E+00	-.2545E+06	-.8184E+06	.7654E+03
.9575E+02	-.2792E+04	-.1643E+02	-.2500E+05	.1329E+05	-.1635E+03	-.9643E+00	-.2544E+06	-.8184E+06	.7626E+03
.9585E+02	-.2793E+04	-.1645E+02	-.2500E+05	.1330E+05	-.1636E+03	-.9642E+00	-.2544E+06	-.8184E+06	.7598E+03

TRANSIENT RESULTS:

TIME=	XNENG=	VSHIP=	TJENG=	PWRENG=	XNPROP=	SHADVR=	THPROP=	TQPROP=	REACH=
.9595E+02	-.2795E+04	-.1647E+02	-.2500E+05	.1330E+05	-.1637E+03	-.9641E+00	-.2544E+06	-.8184E+06	.7570E+03
.9605E+02	-.2796E+04	-.1650E+02	-.2500E+05	.1331E+05	-.1638E+03	-.9641E+00	-.2543E+06	-.8185E+06	.7543E+03
.9615E+02	-.2797E+04	-.1652E+02	-.2500E+05	.1332E+05	-.1638E+03	-.9640E+00	-.2543E+06	-.8185E+06	.7515E+03
.9625E+02	-.2799E+04	-.1654E+02	-.2500E+05	.1332E+05	-.1639E+03	-.9640E+00	-.2543E+06	-.8185E+06	.7487E+03
.9635E+02	-.2800E+04	-.1656E+02	-.2500E+05	.1333E+05	-.1640E+03	-.9639E+00	-.2542E+06	-.8185E+06	.7459E+03
.9645E+02	-.2801E+04	-.1658E+02	-.2500E+05	.1334E+05	-.1641E+03	-.9639E+00	-.2542E+06	-.8185E+06	.7431E+03
.9655E+02	-.2803E+04	-.1660E+02	-.2500E+05	.1334E+05	-.1641E+03	-.9638E+00	-.2542E+06	-.8185E+06	.7403E+03
.9665E+02	-.2804E+04	-.1663E+02	-.2500E+05	.1335E+05	-.1642E+03	-.9637E+00	-.2541E+06	-.8185E+06	.7375E+03
.9675E+02	-.2805E+04	-.1665E+02	-.2500E+05	.1335E+05	-.1643E+03	-.9637E+00	-.2541E+06	-.8185E+06	.7347E+03
.9685E+02	-.2807E+04	-.1667E+02	-.2500E+05	.1336E+05	-.1644E+03	-.9636E+00	-.2540E+06	-.8186E+06	.7319E+03
.9695E+02	-.2808E+04	-.1669E+02	-.2500E+05	.1337E+05	-.1645E+03	-.9636E+00	-.2540E+06	-.8186E+06	.7290E+03
.9705E+02	-.2809E+04	-.1671E+02	-.2500E+05	.1337E+05	-.1645E+03	-.9635E+00	-.2540E+06	-.8186E+06	.7262E+03
.9715E+02	-.2811E+04	-.1673E+02	-.2500E+05	.1338E+05	-.1646E+03	-.9635E+00	-.2539E+06	-.8186E+06	.7234E+03
.9725E+02	-.2812E+04	-.1675E+02	-.2500E+05	.1339E+05	-.1647E+03	-.9634E+00	-.2539E+06	-.8186E+06	.7206E+03
.9735E+02	-.2813E+04	-.1677E+02	-.2500E+05	.1339E+05	-.1648E+03	-.9634E+00	-.2539E+06	-.8186E+06	.7177E+03
.9745E+02	-.2815E+04	-.1679E+02	-.2500E+05	.1340E+05	-.1648E+03	-.9633E+00	-.2538E+06	-.8186E+06	.7149E+03
.9755E+02	-.2816E+04	-.1681E+02	-.2500E+05	.1340E+05	-.1649E+03	-.9632E+00	-.2538E+06	-.8186E+06	.7121E+03
.9765E+02	-.2817E+04	-.1684E+02	-.2500E+05	.1341E+05	-.1650E+03	-.9632E+00	-.2538E+06	-.8186E+06	.7092E+03
.9775E+02	-.2818E+04	-.1686E+02	-.2500E+05	.1342E+05	-.1651E+03	-.9631E+00	-.2537E+06	-.8186E+06	.7064E+03
.9785E+02	-.2820E+04	-.1688E+02	-.2500E+05	.1342E+05	-.1651E+03	-.9631E+00	-.2537E+06	-.8187E+06	.7036E+03
.9795E+02	-.2821E+04	-.1690E+02	-.2500E+05	.1343E+05	-.1652E+03	-.9630E+00	-.2536E+06	-.8187E+06	.7007E+03
.9805E+02	-.2822E+04	-.1692E+02	-.2500E+05	.1343E+05	-.1653E+03	-.9630E+00	-.2536E+06	-.8187E+06	.6978E+03
.9815E+02	-.2824E+04	-.1694E+02	-.2500E+05	.1344E+05	-.1654E+03	-.9629E+00	-.2536E+06	-.8187E+06	.6950E+03
.9825E+02	-.2825E+04	-.1696E+02	-.2500E+05	.1345E+05	-.1654E+03	-.9629E+00	-.2535E+06	-.8187E+06	.6921E+03
.9835E+02	-.2826E+04	-.1698E+02	-.2500E+05	.1345E+05	-.1655E+03	-.9628E+00	-.2535E+06	-.8187E+06	.6893E+03
.9845E+02	-.2827E+04	-.1700E+02	-.2500E+05	.1346E+05	-.1656E+03	-.9628E+00	-.2535E+06	-.8187E+06	.6864E+03
.9855E+02	-.2828E+04	-.1701E+02	-.2500E+05	.1346E+05	-.1657E+03	-.9627E+00	-.2534E+06	-.8187E+06	.6835E+03
.9865E+02	-.2830E+04	-.1703E+02	-.2500E+05	.1347E+05	-.1657E+03	-.9627E+00	-.2534E+06	-.8187E+06	.6807E+03
.9875E+02	-.2831E+04	-.1705E+02	-.2500E+05	.1348E+05	-.1658E+03	-.9626E+00	-.2534E+06	-.8187E+06	.6778E+03
.9885E+02	-.2832E+04	-.1707E+02	-.2500E+05	.1348E+05	-.1659E+03	-.9626E+00	-.2533E+06	-.8188E+06	.6749E+03
.9895E+02	-.2833E+04	-.1709E+02	-.2500E+05	.1349E+05	-.1659E+03	-.9625E+00	-.2533E+06	-.8188E+06	.6720E+03
.9905E+02	-.2835E+04	-.1711E+02	-.2500E+05	.1349E+05	-.1660E+03	-.9625E+00	-.2533E+06	-.8188E+06	.6691E+03
.9915E+02	-.2836E+04	-.1713E+02	-.2500E+05	.1350E+05	-.1661E+03	-.9624E+00	-.2532E+06	-.8188E+06	.6662E+03
.9925E+02	-.2837E+04	-.1715E+02	-.2500E+05	.1350E+05	-.1661E+03	-.9624E+00	-.2532E+06	-.8188E+06	.6633E+03
.9935E+02	-.2838E+04	-.1717E+02	-.2500E+05	.1351E+05	-.1662E+03	-.9623E+00	-.2532E+06	-.8188E+06	.6605E+03
.9945E+02	-.2839E+04	-.1719E+02	-.2500E+05	.1352E+05	-.1663E+03	-.9623E+00	-.2531E+06	-.8188E+06	.6576E+03
.9955E+02	-.2841E+04	-.1720E+02	-.2500E+05	.1352E+05	-.1664E+03	-.9622E+00	-.2531E+06	-.8188E+06	.6547E+03
.9965E+02	-.2842E+04	-.1722E+02	-.2500E+05	.1353E+05	-.1664E+03	-.9622E+00	-.2531E+06	-.8189E+06	.6517E+03
.9975E+02	-.2843E+04	-.1724E+02	-.2500E+05	.1353E+05	-.1665E+03	-.9622E+00	-.2531E+06	-.8189E+06	.6488E+03
.9985E+02	-.2844E+04	-.1726E+02	-.2500E+05	.1354E+05	-.1666E+03	-.9621E+00	-.2530E+06	-.8189E+06	.6459E+03
.9995E+02	-.2845E+04	-.1728E+02	-.2500E+05	.1354E+05	-.1666E+03	-.9621E+00	-.2530E+06	-.8189E+06	.6430E+03

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